ALPHATECH, INC.

FINAL REPORT

DEVELOPMENT AND EVALUATION OF A PROGRAM FOR TRAINING INFORMATION MANAGEMENT IN DISTRIBUTED ORGANIZATIONS

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14. ABSTRACT *(Maximum 200 words)*:
A theory-based model of information management was created to develop a training program to train effective information management. The training program focused on the specific behaviors "prepare, filter, scan, read, and act" and helped information managers deal more effectively with large amounts of information. Implicated ways in which the training paradigm could be improved and developed even further. The program fits in a niche that has been overlooked by researchers. The program focused exclusively on the process necessary to manage and integrate large amounts of information. This paper concludes that until automatic filtering systems improve dramatically enough to make the need for human filtering obsolete, a training program that focuses on specific behaviors such as Prep, Filter, Scan, Read, and Act can help people manage large amounts of information more effectively. Not only can people learn to better recognize and focus on important information, but they can learn to change behavior in such a way that they no longer contributes to other people's overload.

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Training Program, Information Management, Distributed Organizations, Information Overload

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Development and Evaluation of a Program for Training Information Management in Distributed Organizations

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October 2000

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EXECUTIVE SUMMARY

The need for effective information management processes has become more urgent as the amount of information available has increase exponentially. Information that formerly had to be sent through the mail or via messengers to individual recipients can now be disseminated almost instantaneously with a single keystroke to huge numbers of recipients in widespread locations. Such freedom in information exchange is advantageous in that more people are more able to find information they need for problem solving and decision making; however, one disadvantage of such free flowing information is the possibility of being exposed to more information than can be comprehended, a state known as information overload.

In this project we developed a model of information management that was derived from sound cognitive theories as well as empirical observations of individuals attempting to manage information. The model describes the process by which incoming information is filtered, assessed, consumed or acted upon, and disseminated, and information gaps are filled by seeking additional information. In this model, we theorized that knowledge of the organization in which one is operating is a critical aspect of efficient information generation; it is only with such organizational knowledge that information disseminators can reduce the inadvertent information overload caused by thoughtless information propagation.

Using the initial model and observations as guides, we developed an information management training program designed to help information managers cope effectively and efficiently with large volumes of incoming information, and, at the same time, control the spread of information by effective and efficient information generation. Information processing activities generally occur in the context of some planning, problem solving, or decision-making task in an

organization; for this project we oriented the training to information management in military organizations.

A preliminary version of the information management training program focused on helping information managers to define their information needs and enhance their depth of knowledge. For a military context, we focused knowledge-based training on increasing their understanding of the mission, their role in the mission, and the organizational structure in which the mission is occurring. In a pilot study we administered the training program to a group of cadets at the United States Military Academy at West Point. Although the training fostered more effective high level information filtering, it did not help participants comprehend and integrate the incoming information. We concluded that the program needed a stronger focus on behavioral training that emphasized specific information management techniques. We also concluded that organizational knowledge needed to be incorporated directly into the information management training program, rather than being provided as a separate component, as was done in the pilot study.

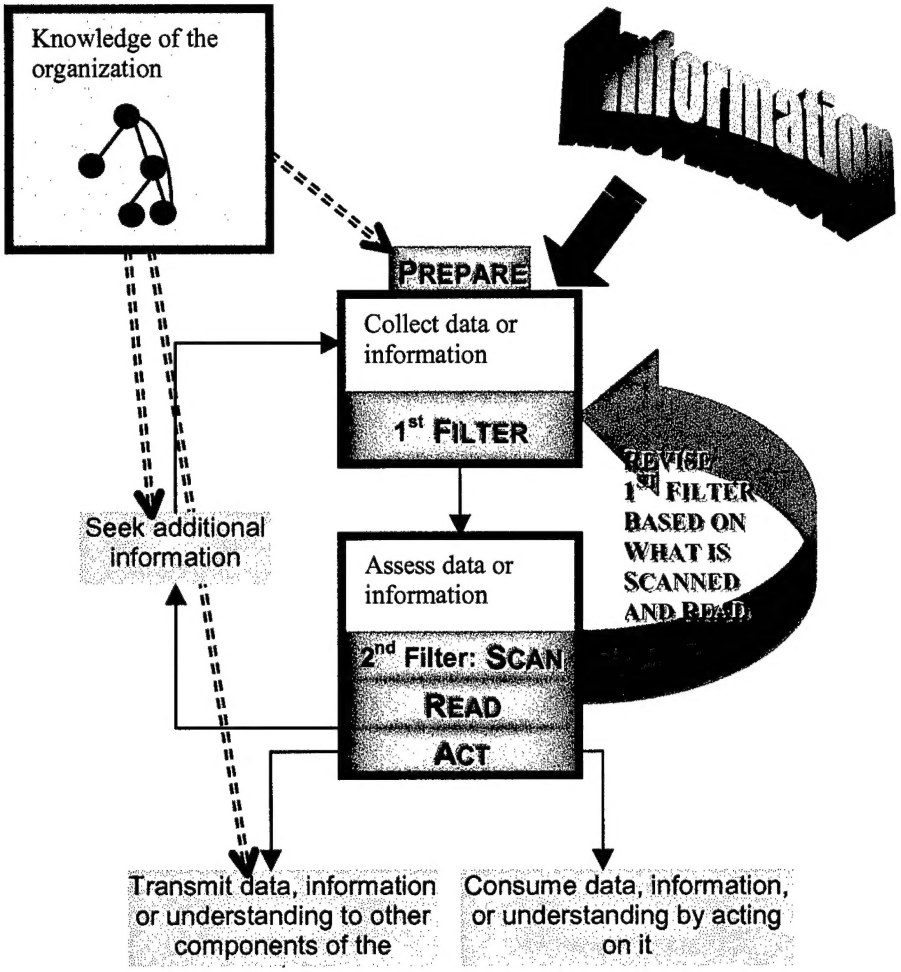
Based on the results of the pilot study, we developed the test version of the information management training program, and centered it around a five-step behaviorally oriented approach – Prepare, filter, scan, read, act – that trainees can use to process incoming information. We set the program in the context of the Military Decision Making Process (MDMP) that military officers learn, and motivated it by a discussion of how information overload occurs and the cognitive and psychological results that it imposes. The program was comprised of four components needed for effective training – lecture, demonstration, practice, and feedback.

We administered the training program to mid-career officers at the Battle Command Battle Laboratory at Fort Leavenworth, and assessed its effectiveness by comparing the information processing performance of the trained subjects to that of a control group. The results showed the that IM training program was successful in fostering more effective information management

processes, and in mitigating some of the known information processing errors that have been observed. Trained subjects were more effective at higher level filtering, opening more critical and fewer nonrelevant messages. They were more able to recognize critical messages and better able to integrate the information in the messages to form a higher quality situation assessment. Trained subjects were also more effective information generators, transmitting fewer but more critical messages, and sending them to more appropriate and more specific nodes.

The overall evaluation of the training program demonstrated that it was successful in counteracting many of the typical errors that occur in information management. The individuals who participated in the training evaluation at Fort Leavenworth are mid-career officers, all of whom already have intensive training on information management, and many of whom have had extensive experience as information managers. That we were able to demonstrate positive effects of a two-hour training program attests to its effectiveness and promise.

We revised the information management model that had served as a basis for our work to to incorporate the results of the training development and evaluation. The updated model, shown in the figure below, makes explicit the importance of initial preparation in information, shows how key words and phrases identified in preparation can be used in scanning messages to determine whether they contain important information, better depicts the dynamic nature of information management, and emphasizes the importance of knowledge of the organization in which the information processing activities are occurring. The model incorporates a feedback loop emphasizing that information management is a dynamic process in which critical information needs and sources can change over time. It also shows how organizational knowledge impacts information seeking and transmission.


Knowledge of the organization
Information
PREPARE
Collect data or information
1st FILTER
REVISE 1st FILTER BASED ON WHAT IS SCANNED AND READ
Seek additional information
Assess data or information
2nd Filter: SCAN
READ
ACT
Transmit data, information or understanding to other components of the
Consume data, information, or understanding by acting on it

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We acknowledge the cooperation of the Battle Command Battle Laboratory (BCBL) at Fort Leavenworth, KS. We thank Col. Michael Heredia, BCBL Deputy Director, who supported the evaluation of the test version of the Information Management Training Program. We thank him and his staff for allowing us to use the Futures Laboratory of the BCBL to conduct the training evaluation. We thank Col. Heredia and Mr. Michael Freeman for scheduling participants in the training evaluation. We thank the officers and other members of the BCBL staff who graciously participated in the training evaluation. We thank Dr. Stan Halpin, director, and Dr. Angela Karrasch of the the Army Research Institute Field Unit at Fort Leavenworth, who were instrumental in helping us schedule the training evaluation at the BCBL, and supported us in the conduct of the experiment.

Major James Donlon served as a subject matter expert during the development of the training materials and the evaluation scenario for the test version of the training program. We are grateful for the knowledge and dedication he brought to this work, and for the insights into

military processes that he provided. We thank Major Michael Williams who supported us in the evaluation of the BCBL participants' situation assessment briefings for his efforts and responsiveness.

CHAPTER 1

DEVELOPMENT AND EMPIRICAL INVESTIGATION OF AN INFORMATION MANAGEMENT MODEL

In this report we describe the development, implementation, and assessment of an information management (IM) training program. The focus and contents of the training program were based on requirements identified in an IM model derived from empirical observations of decision makers in various domains and on the findings from an empirical investigation of IM under varying levels of information load. Detailed reports on the model and experiment are found in Entin, Kerrigan, Serfaty, Klein, and Wolf (1996 and 1998, respectively). In this chapter we summarize the IM model and experiment, with a focus on how they set the stage for the IM training program detailed in the following chapters.

Chapter 2 describes the initial version of the IM training program we developed and evaluated. Chapter 3 describes the design, contents, and evaluation of the second version of the training program. Chapter 4 summarizes our findings, reassesses the IM model in light of the evaluations we conducted, and suggests directions for future work.

1.1 MOTIVATION

The vision of the Chairman, Joint Chiefs of Staff for warfare in the information age (Warfighting Vision, 2010) stresses the importance, and the potential problems, of the information management and interconnectivity implied by information dominance concepts (Alberts, 1996), asserting that information management could be a major limitation in C4I systems. DiNardo and Hughes (1995) recognized data overload as one of the dangers of improved communication technology, because commanders can become so overwhelmed with extraneous information that the real issues can be obscured. One case in point is Desert Storm, where the Joint Forces Commander received more than 1.3 million messages during the first 24 hours. To ensure that

staff and commanders can find the important information, it is essential to reduce this number to a more manageable level in future conflicts.

At the time of the first IM experiment, few researchers had rigorously investigated how human warfighters could best take advantage of the potential of information-rich networked command and control organizations without becoming overwhelmed. We know that a critical component of military command expertise is the ability to focus on important information, identify missing information, and "ask the right questions" when assessing a situation (Serfaty, MacMillan, Entin, and Entin, 1996), but it is not clear how someone lacking this expertise can best learn these behaviors. A goal of the current research program was to develop a training program to facilitate IM for the non-expert.

1.2 DEFINITION AND MODEL OF INFORMATION MANAGEMENT

For the purposes of this study, IM was defined as a set of cognitive processes and behaviors that include the receiving, filtering, integrating, processing, seeking, and exchanging of information by an individual decision maker in an organization. Figure 1-1 shows the problem of IM from the perspective of the information receiver. The information manager has a finite amount of information needs – that information required for effective performance – but receives much more information from

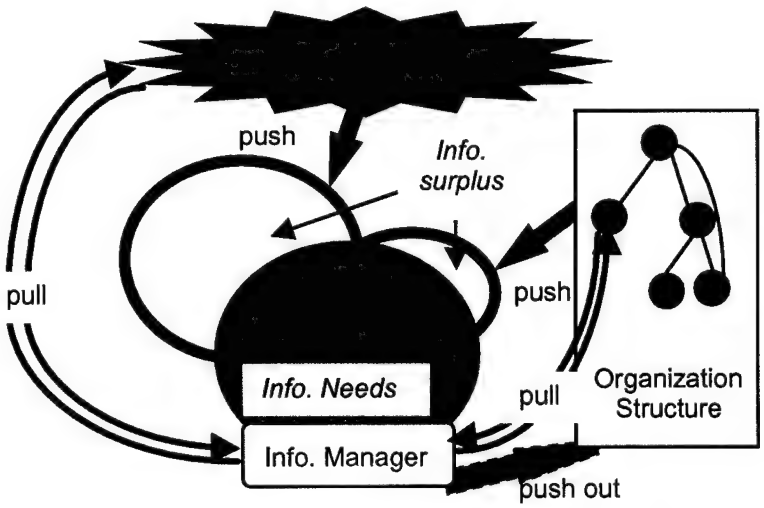

Figure 1-1. Information Management for One DM

external sources such as the environment or the structure of the organization than is required. Despite this massive information push, there will still be information that the information manager must seek. The ability to filter information and recognize information gaps is becoming increasingly important as the information dissemination technology continues to develop faster than automatic information filters. The ensuing free-flow of information results in a flatter command and control (C2) organization in which everyone has access to more data than ever before. Those who cannot manage information succumb to information overload (See Figure 1-2). The goal of this program was to develop theory-driven training methods that will enhance effective IM skills and practices, allowing individuals to effectively filter incoming information and focus on *needed* rather than *surplus* information, and, at the same time, to recognize their critical information needs, and seek that information from the appropriate sources.

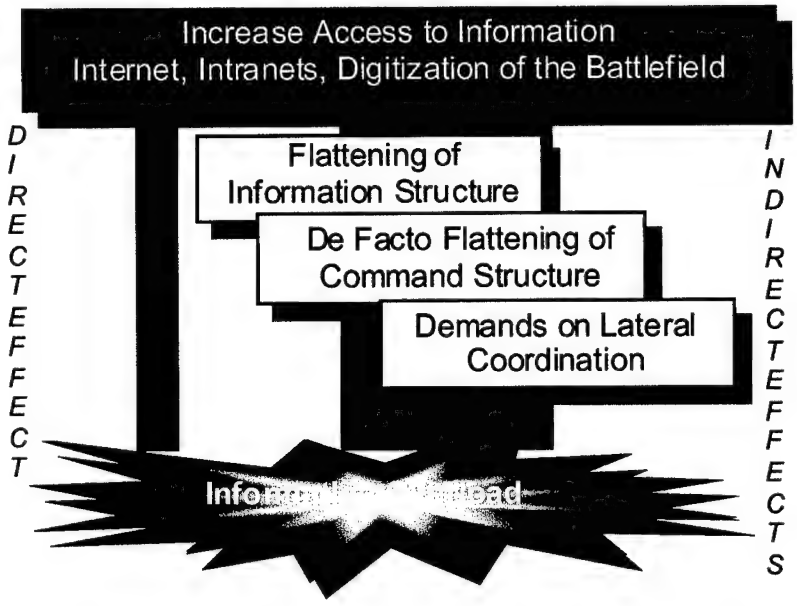

Figure 1-2. Information Overload in C2 Organizations

Given the definition that IM is a set of cognitive processes, a cognition-based model of IM was developed (see Figure 1-3) and used to guide the experimental design as well as the development and use of innovative information flow measures to capture the key processes underlying IM in a

C2 organization. This model of IM is based on observations of decision makers in more than 20 different domains including urban and wildland firefighters, Army and Marine tactical operation center personnel, JFACC planners, Army air defense planners, Navy commanders, Navy combat information center staff, and many others. Each of these domains is characterized by decision making under high stakes, high stress, and high time pressure, using limited information from multiple sources. The resultant model is not complicated, it can be viewed in simplest terms as: receive some set of information, determine what that information means, and act on it. Other key aspects of this IM model are the two levels of filtering necessary for good IM skills. The first, or "higher level," filter can be viewed as a simple gate that is set to reject or accept the information for further processing based on immediately available characteristics (e.g., source and subject), whereas the second, or "low level," filter is based on a more complete processing of the information (e.g., reading the entire message).

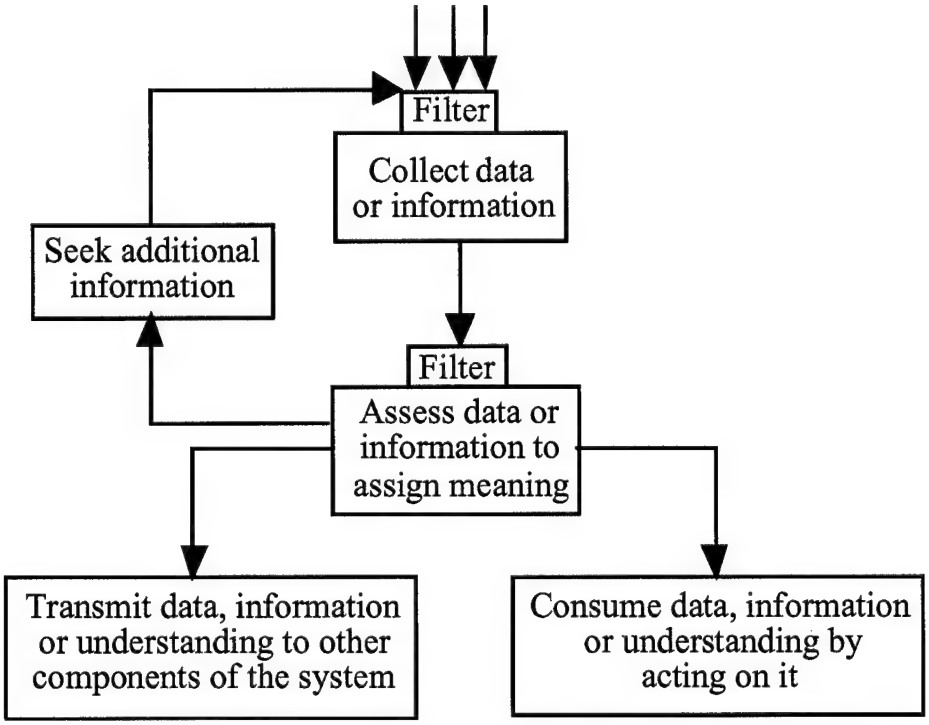

Figure 1-3. Conceptual Model of Information Management

As with any cognitive process, errors are typically an integral part of managing information and can occur at any step in the IM process; Figure 1-4 illustrates the most common errors seen in IM. For example, errors can occur at the high level filter when the information manager decides to pursue irrelevant information or ignores important information, or at the low level filter if the information manager fails to disregard obsolete information, or becomes distracted by interesting information that is not relevant for the mission at hand. There can also be errors in information transmission and information seeking behaviors.

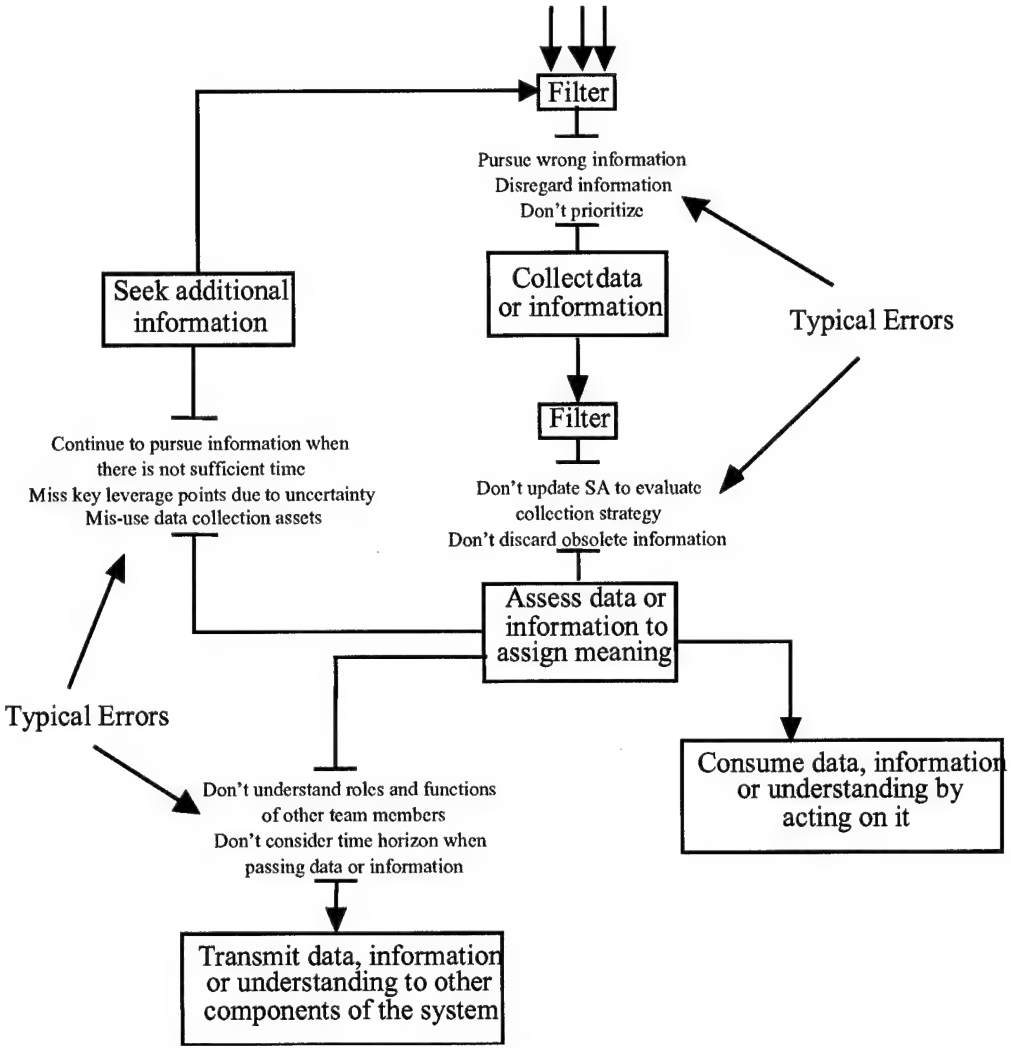

Figure 1-4. Potential Errors in the Information Management Process

1.3 EMPIRICAL ASSESSMENT OF INFORMATION MANAGEMENT

Based in the IM model and the associated IM processing errors that have been observed, we developed and conducted an experiment to validate the cognitive model of information management including the possible errors, and to empirically identify IM strategies, techniques, and skills amenable to enhancement through training that can prevent these errors from happening. In particular, we sought to identify skills that were especially vulnerable under conditions of high information load, and to develop strategies to mitigate the deleterious effects of information overload.

The two major independent variables implemented in this experiment, information load and knowledge of organization structure. *Information load* was implemented as a within-subjects variable with two levels, moderate and high. In the moderate information load condition there was a reasonable rate of information flow, whereas in the high information load condition the individual was deluged with information. The information necessary for understanding and assessment of the evolving situation was provided in both the high and moderate load conditions. *Knowledge of organizational structure* was implemented as a between-subjects variable with two levels, shallow and deep. For shallow knowledge, we provided a diagram of the organizational structure and a one-line description of each available node. For deep knowledge, we supplemented the diagram with a detailed written description of the roles and functions of each node, and the classes of information possessed and required by each node. We used an unconventional, futuristic organization so participants could not easily tap into existing knowledge.

The major performance tasks were periodic situation assessment briefings, both oral and written. Workload was assessed using the The Task Load Index (TLX; Hart and Staveland, 1988). Several self-report measures were developed based on participants' responses to items in Post-Trial and Post-Experiment Questionnaires.

Participants were required to rate the importance of all incoming messages that they opened on a 4-point scale ranging from irrelevant to highly critical. Participants were also permitted to send messages to different nodes in the organizational structure to ask for more information about the situation, or to forward messages to another node. Two dependent measures were developed for messages sent out by participants: node level (subordinate, lateral and superior) and node appropriateness (was the message sent to an appropriate or inappropriate node).

The basic scenario is set in the year 2008. The United States is leading a multi-national, combined task force (CTF) to implement a United Nations resolution condemning a Country A's invasion of its neighbor, Country B. The scenario materials included: a basic introduction to the scenario describing the geopolitical situation and the events leading up to the current situation; a wall map showing a detailed view of the general area in which the scenario is occurring; two vignettes based on the general scenario; a smaller desk map showing a narrower view of the tactical situation for each vignette, plus two overlays for the desk map showing changes in the tactical situation, and; a stream of electronic, telephone, and handwritten messages associated with each vignette, some of which are viewed as critical to a situation assessment and others of which do not contain essential information.

The Distributed Dynamic Decision-making (DDD) simulator (Serfaty and Kleinman, 1985; Kleinman and Serfaty, 1989) was used as the experiment testbed. It was modified to include a message-sending capability whereby a set of preplanned messages could be incorporated into the scenario and sent out as electronic messages at specified times in the execution of a scenario. Other new features incorporated into the DDD simulator include a message listing panel, which displays external message markers such as the time and subject of a message, and a mechanism for rating both incoming and outgoing messages.

Sixteen military offers participated in the experiment. Because the amount of time available for experiment sessions was limited, participants were given the background scenario materials two weeks prior to the experiment and asked to read and review all materials they received before participating in the first experiment session. Figure 1-5 provides a high-level overview of the experiment design and procedure. Each participant participated individually in two experiment sessions.

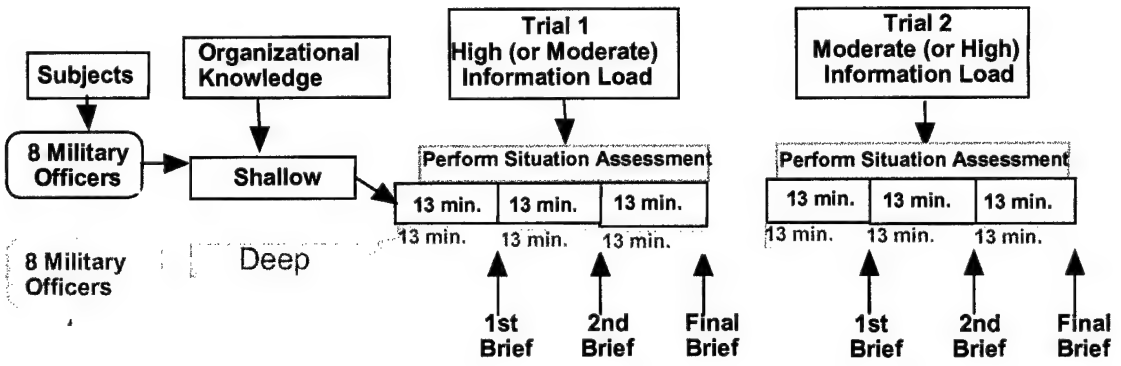

Figure 1-5 Overview of Experiment Design and Procedure

Analysis of the workload ratings confirmed that subjects experienced a significantly higher workload in the high information load condition. The results revealed that participants could more accurately assess the situation when exposed to a moderate level of information load than when exposed to a high information load. The problems exacerbated by high level of information load were: 1) difficulty recognizing critical information and 2) difficulty in filtering out noncritical information. Figure 1-6 provides a summary of the errors exhibited by the participants in this first experiment. Specifically, it was found that participants had a difficult time formulating and directing messages – too many messages (many inappropriate) were sent to subordinates and the messages, if forwarded without change, were more likely to be misdirected.

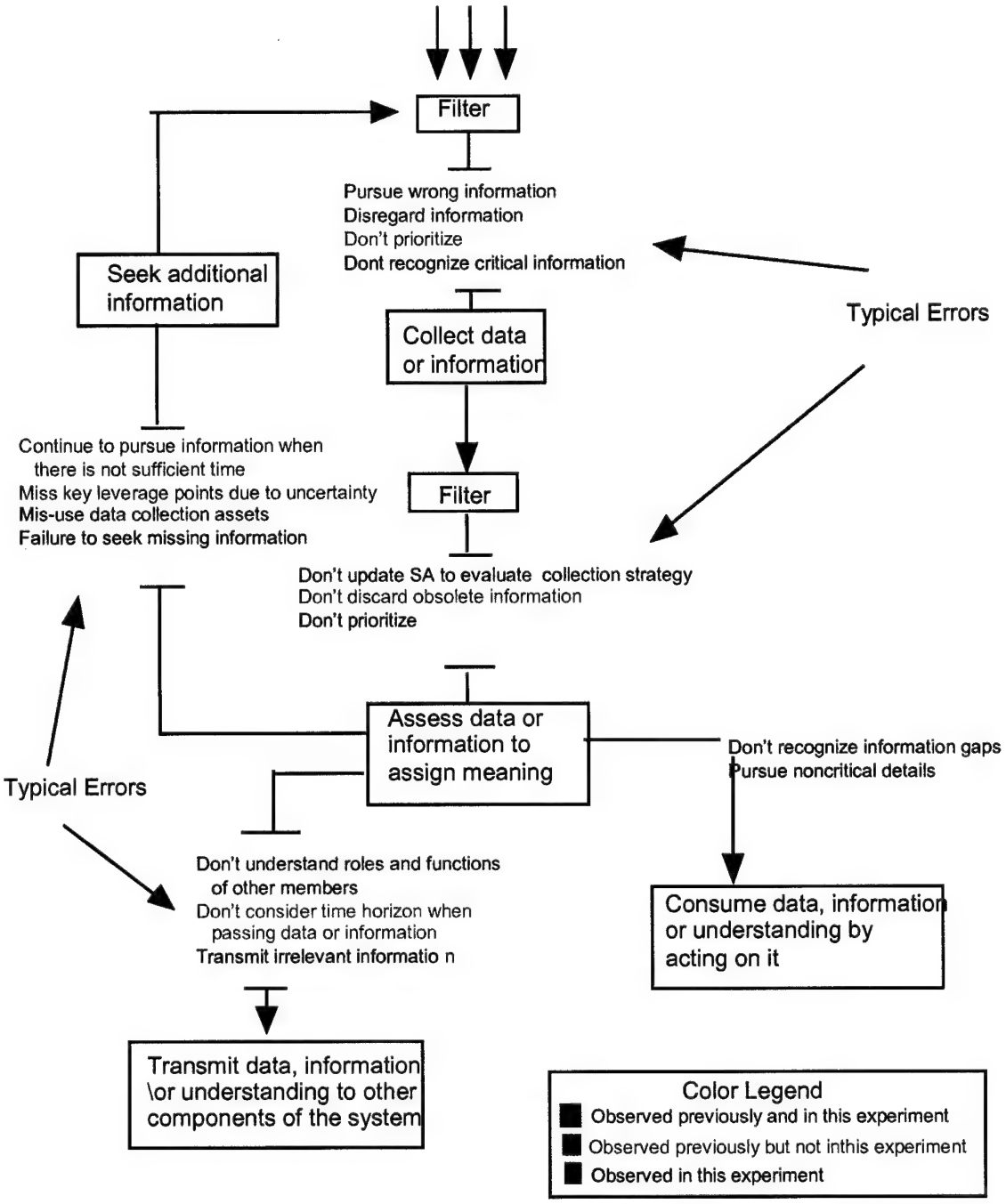

Figure 1-6. Observed Errors and Difficulties in Information Management

Evidence also suggested that a deeper level of organizational knowledge facilitated the transfer of information to the appropriate nodes in the organization when information load was high, although the exact effect of deep organizational knowledge was attenuated because most participants indicated on the post experiment questionnaire that they did not have sufficient time prior to the experiment to read through all of the pre-experiment packet.

1.4 TRAINING IMPLICATIONS

Based on the experiment and other empirical findings, we identified two high level objectives for an IM training program designed to enhance effective IM skills and practices: 1) Training associated with the identification of one's own information requirements to help decision-makers recognize their critical information needs and focus on needed rather than surplus information, and; 2) Enhancement of organizational knowledge to provide decision makers with a clearer understanding of the needs and capabilities of other nodes in the organization and the lines of communication among the nodes, and thereby facilitate effective and efficient information interchange among the nodes.

The proposed approach for implementing the training program suggested that some of the training should focus on the ***knowledge*** of the individuals, specifically defining information needs, and enhancing depth or level of knowledge. The most important skill the subjects in the experiment seemed to be missing was the ability to recognize critical information (i.e., *define critical needs*). It was concluded that participants need focused understanding of the mission, of their role in the mission, and of the tasks they are called upon to perform to fulfill their role in the mission. The approach also suggested that *enhancing depth or level of organizational knowledge* is another important area for increased knowledge since the original study found some support that

an increase in organizational knowledge helped counteract the effects of massive amounts of information.

The empirical results suggested that participants need to have some ***procedural training*** in addition to the knowledge training. It was apparent in the experiment that not only did the subjects not know where to send or get messages, but they did not know how to send or get messages. It was proposed that participants needed training in how and where to send information (information push) and how and where to get information (information pull).

CHAPTER 2

INFORMATION MANAGEMENT TRAINING PROGRAM: DEVELOPMENT AND ASSESSMENT OF A PRELIMINARY VERSION

Based on the information management (IM) model and experiment findings described in the previous chapter, the ALPHATECH/Aptima team developed a preliminary version of an IM training program. In this chapter we describe this initial version and the conduct of a pilot study to explore the appropriateness of that program. The results from the pilot study were intended to be used in the further development of the training program. Section 2.1 contains the description of the content and format of the training program; Section 2.2 explains the materials and method we used to assess the appropriateness and effectiveness of the program; Section 2.3 describes the pilot evaluation that we conducted; and Section 2.4 discusses the conclusions and implications we drew from the pilot investigation.

2.1 DEVELOPMENT OF TRAINING PROGRAM

2.1.1 Description of the Training Program

Based on the findings of the Experiment 1 (described in Chapter 1), a preliminary IM Training Program was developed to enhance two knowledge bases: defining information needs and enhancing depth or level of knowledge. For information managers working in a military context, we hypothesized that knowledge-based training focused on increasing their understanding of the mission, their role in the mission, the tasks they are called upon to perform to fulfill their role in the mission, as well as the organizational structure in which their mission is occurring will help them deal with massive amounts of information. In effect, the training program attempted to help information processors wade through massive amounts of information, focusing on the relevant information while disregarding irrelevant information. The actual training program is described below. The training was conducted and evaluated at the United States Military

Academy at West Point with upper-class cadets enrolled in a systems engineering class. It is important to note that the style and content of the training materials was developed with this audience in mind.

Participants in the IM Training Program received extensive training (lecture-style instruction and a written demonstration) aimed at increasing their ability to assess the situation, be more aware of time horizons, and help them handle uncertainty and time constraints using the mnemonic MISSION. The M in Mission corresponds with "delineate Mission;" the I corresponds with "Identify critical elements of information;" the first S corresponds with "Specify messages that could help you;" the second S corresponds with "Speculate how you might help others;" the second I corresponds with "Ignore irrelevant information;" the O corresponds with "Observe time constraints;" and the N corresponds with "keep a Narrow focus." We believed that learning this mnemonic would help inexperienced information processors and decision-makers, such as the West Point cadets, focus on the relevant information while disregarding the irrelevant information. In other words, it would help the novice become more expert in identifying and processing critical information and subsequently in making effective decisions.

Information management training was implemented in a lecture/demonstration format. For the lecture portion subjects received a booklet and followed along with the trainer (Figure 2-1 is the cover sheet for the Information Management manual). The subjects were told that the purpose of the training was to help them sift through large amounts of information, determining what is important and what is not. It was explained to them that there are a number of things that must be done to effectively deal with large amounts of information and that the manual being used for the training breaks them down into the following seven parts:

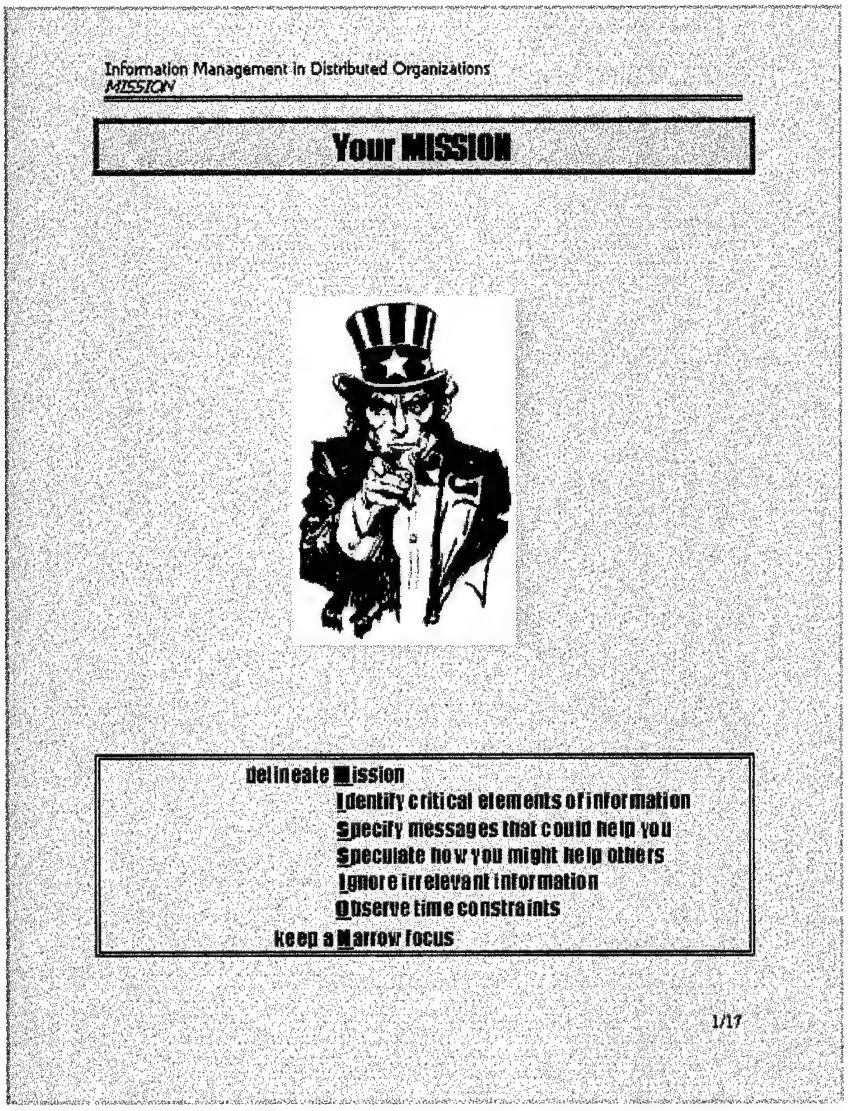

Figure 2-1. Cover for Training Manual

1) delineate **M**ission

2) **I**dentify critical elements of information

3) **S**pecify messages that could help you

4) **S**peculate how you might help others

5) **I**gnore irrelevant information

6) **O**bserve time constraints

7) keep a **N**arrow focus

For each of these seven parts the manual contained a thorough explanation about what is meant (labeled "WHAT IS THIS?" in the manual), an example scenario to show how it is ("HOW DO I DO THIS?"), and an opportunity for the subjects to practice with another scenario ("APPLICATION."). It was further explained that although the parts were explained sequentially, they are not steps to be performed in strict order; they should all be thought about at the start of, and throughout, every mission.

After receiving the initial IM training, all subjects were exposed to a written "demonstration" designed to further strengthen the mnemonic MISSION. In this demonstration, subjects read a description of a fictitious incident broken up into seven parts (corresponding to the seven parts described in the training lecture portion described above). Each part was described twice with the first depiction illustrating an incorrect way to handle the situation, and the second depiction illustrating a better way to handle things. As a group the trainer and the participants read the scenes as presented and answered questions designed to strengthen the participants' ability to focus on their MISSION.

2.1.2 Description of Control Training

To evaluate the effectiveness of any training program it is necessary to have a control group of subjects, who do not receive the training but receive some comparable instruction-type interaction, against which to compare the trained subjects. To provide a counterpart to the IM training program we developed another set of materials, which we refer to as the control training, that we used with the control group. This control training was implemented in a similar lecture format as that used for the IM training.

Because the scenario they would be participating in was set in the future (2008), the control training focused on the Army of the future since such training could be seen as "setting the stage" for the experimental scenario. Similar to the IM training, the control training was divided

into two parts, the first of which focused on how the changes in the Army might affect the subjects personally (Figure 2-2 is the cover for the control training manual), then the second part was a more general overview of the Army After Next. It was explained that, since allied forces were joint in the experimental scenario, some background on the vision for the Army After Next would set the stage for the exercise.

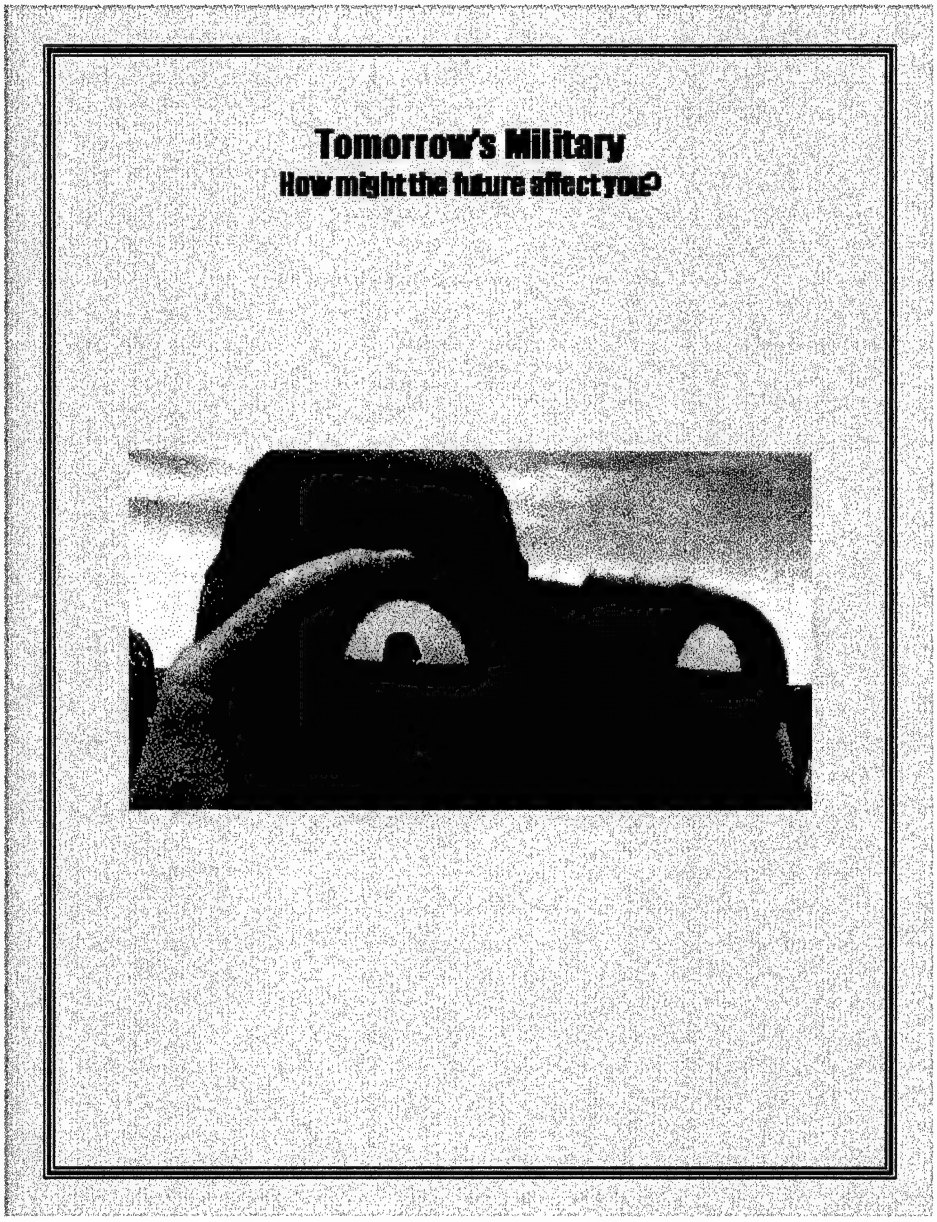

Figure 2-2. Cover for Control Manual

2.2 TRAINING EVALUATION: METHOD

In this section we describe the scenario materials used in the evaluation of the training and the experiment design and procedure that was employed.

2.2.1 Scenario Materials

We used the same basic scenario as was used in the information load experiment described in Chapter 1. The scenario is set in the year 2008. The United States is leading a multi-national, combined task force (CTF) to implement a United Nations resolution condemning an Country A's invasion of its neighbor, Country B. The CTF Commander (CTFC) has established an organizational structure that uses four functional component commanders for air, land, maritime, and special operations joint task forces. The scenario materials used for the evaluation of the IM training included a basic introduction to the scenario describing the geopolitical situation and the events leading up to the current situation, and a large annotated map showing a detailed view of the geographic area in which the scenario was set. A Situation Update bridged from the time described in the basic scenario to the current situation.

The basic scenario sets the stage for the vignette that was used in the experiment. In the vignette, the participant is part of the maritime component, and plays the role of a member of the Force I commander's staff, located on an amphibious command and control ship in the region. The mission is to conduct a situation assessment and determine why enemy armor units have halted in the vicinity of Objective A (labeled on the annotated map). The map was used in the experiment as a means of conveying graphical information was a detailed road map of the two countries involved. The annotations on the map showed the locations of enemy and friendly units as well as named areas of interest.

2.2.2 Organizational Knowledge

Declarative knowledge about the structure and functions of an organization and dynamic knowledge about how the structure is used in a particular situation are two aspects of organizational knowledge. Declarative knowledge includes information about the structure of the organization, communication channels, role and functions of individuals within the organization, and information sources. We hypothesized that participants with deep declarative knowledge of organizational structure will have a better framework for applying aspects of the IM training concerned with the sources of information, the need to forward information, and the subjects of that information.

In the evaluation experiment, there were two levels of organizational knowledge: shallow and deep. To implement shallow knowledge, we provided a one-page summary showing a diagram of the organizational structure and a one-line description of each available node. For deep knowledge, we supplemented the diagram with a detailed written description of the roles and functions of each node, the classes of information possessed and required by each node, and a description of the information flow between the nodes. We used an unconventional, futuristic organization so participants could not easily tap into existing knowledge of a traditional military organizational structure. The Organizational Chart given to the subjects is included in Appendix A. The materials distributed in the shallow organizational knowledge condition (the organizational chart and a one-line functional description for each position) are also included in Appendix A.

We sent a reading packet to the participants in the study ahead of time so they could learn the structure of the fictional organizational before going to the study. The material was divided into small, manageable, segments after each of which there was a self-test to help the participant learn the material. The answers for the self-tests were at the back of the booklet.

2.2.3 Scenario Generator

The scenario generator used for the training evaluation was a tailored version of a JAVA-based mail message software package implemented for a PC running Windows NT. The program was capable of sending messages out at pre-specified times. It could also transmit messages sent by the subjects to other nodes in the organization and transmit back to the subject a response formulated by the controller, who simulated all other nodes.

An example of the main display is shown in Figure 2-3. The message queue lists the messages that have been received. Unopened messages are listed in black and messages that have been opened are listed in grey. To read a message the participant clicks on the message, and it appears in the message listing window. To send a message, the participant clicks on the New Message, Forward, or Reply button located above the message listings.

Figure 2-4 shows an example of the message window, which includes the message header, the source, and the time of the message, the message body. The bottom of the window shows the rating scale used by the participant to evaluate the criticality of the message. Figure 2-5 shows an example of the message generation window, which includes place holders for the intended recipient, the subject, and the body of the message.

2.2.4 Instruments

Five instruments were used during the evaluation experiment, the first four of which were completed by the subjects, and the fifth by an SME evaluator. (See Appendix A for a copy of each of the instruments.)

Organizational Knowledge Questionnaire

This questionnaire was used to assess subjects' knowledge of the organizational structure and the roles and information requirements of the nodes within the organization.

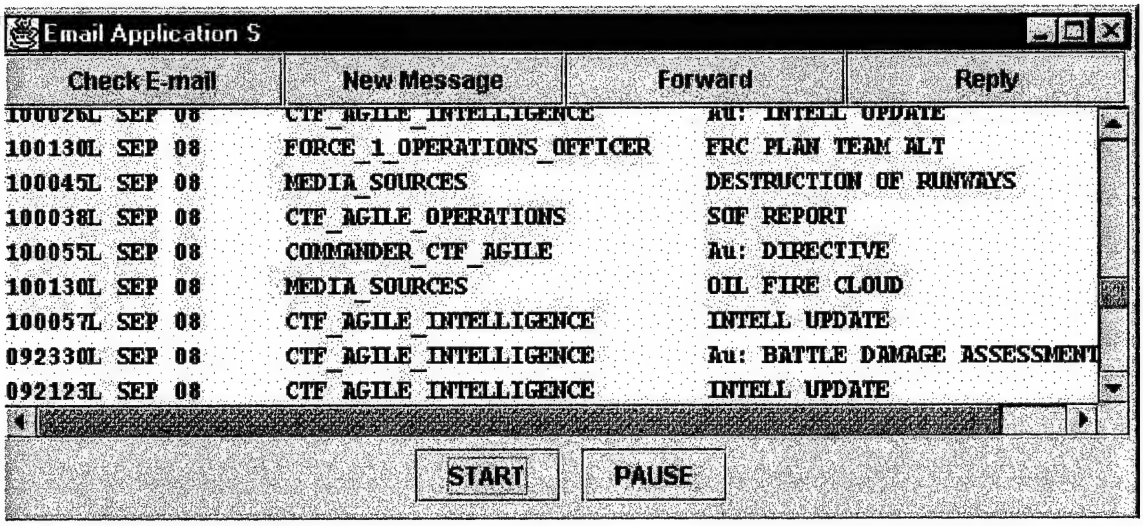

Figure 2-3. Email Message Queue

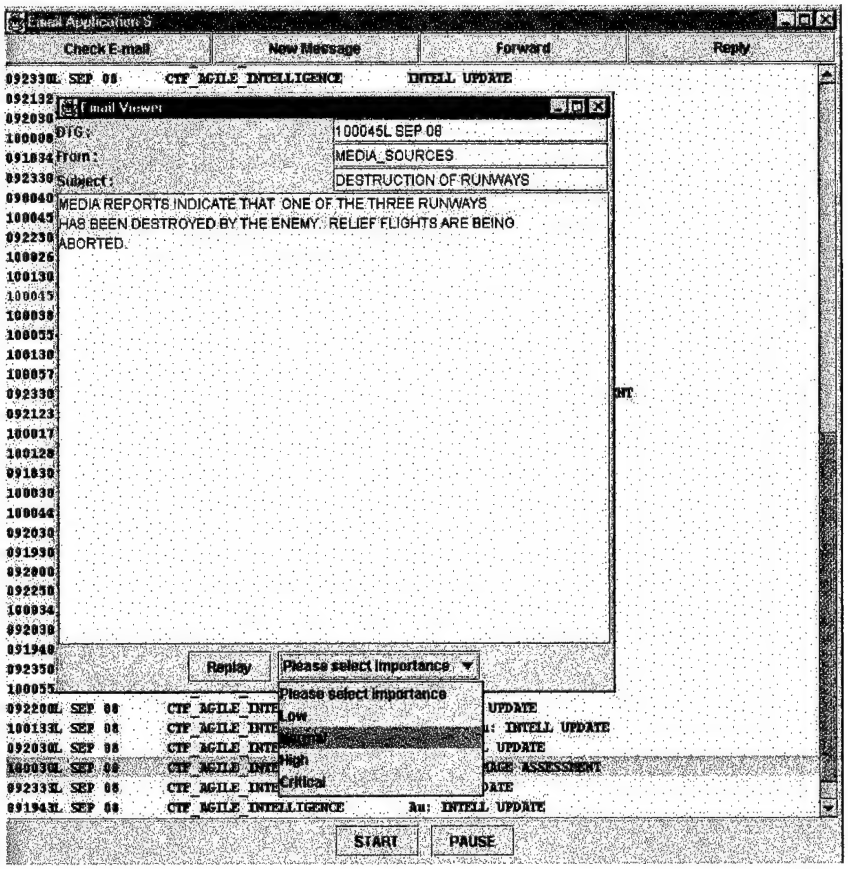

Figure 2-4. Email Message with Importance Rating Menu Pulled Down

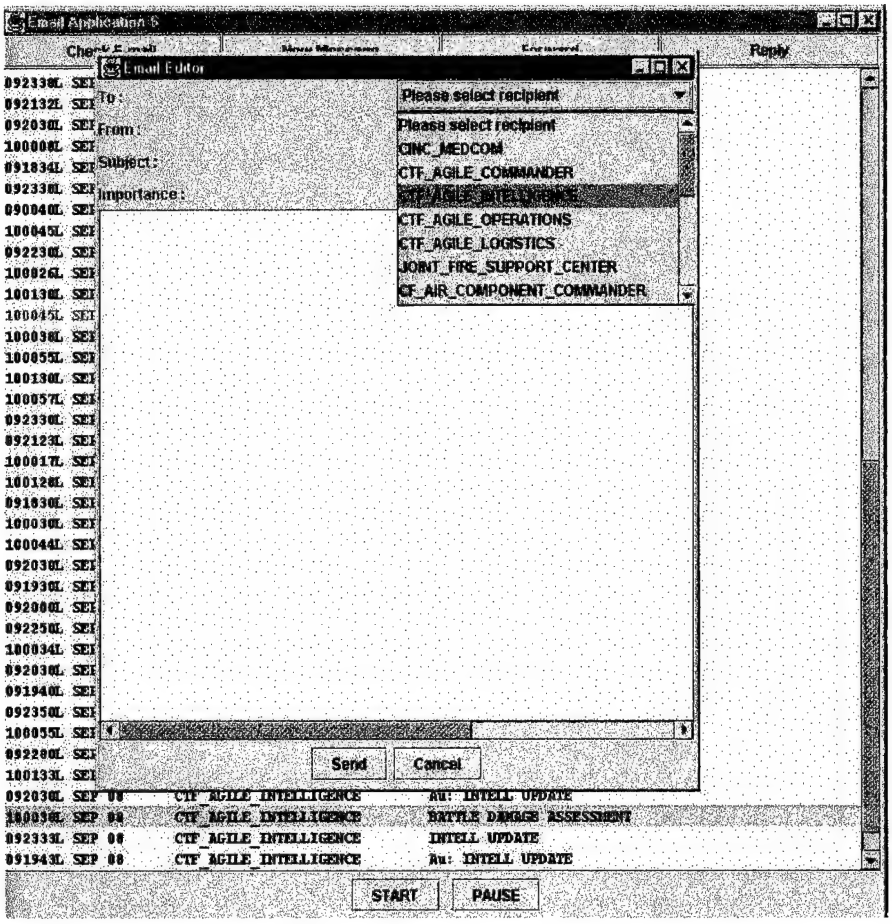

Figure 2-5. Sample of Editor Window Showing Scrollable List of Recipients

Briefing Preparation Form

The Briefing Preparation Form was designed to help subjects prepare the interim and final oral briefings. It was structured around four questions pertaining to uncertainty, potential sources of information, and current situation in the vignette.

Workload Questionnaire

The Task Load Index (TLX; Hart and Staveland, 1988) is a self-report measure that elicits a participant's ratings on six dimensions of workload (mental demand, physical demand, temporal demand, performance, effort, and frustration). The TLX appears to enjoy high validity and reliability (Lysaght et al., 1989). Participants respond using a 20-point graphical scale anchored at one end by the words "very low" and at the other end by the words "very high." For this study, the

mean of each participant's responses to five of the six dimensions (physical demand was excluded because it was not germane to the task being performed) was used as the primary measure of workload.

Post-Experiment Questionnaire

The post-experiment questionnaire was a self-report measure that probed participants' views about the timing of the experiment and asked them to assess the value of the training they received. (See Appendix A for the post-experiment questionnaire.)

Situation Assessment Evaluation Form

The SME who rated the subjects' written and oral briefings used this form to assess aspects of the subjects' briefings and provide an overall rating of the briefing.

2.2.5 Experiment Design

The primary purpose of the experiment was to test the effectiveness of the IM training program we developed. It also assessed the impact of depth of knowledge of organization structure. Three systems engineering classes at the Military Academy participated in the training program. The number of subjects available precluded a fully crossed evaluation design. Subjects were assigned to one of three experiment conditions: 1) IM training with deep organizational knowledge; 2) IM training with shallow organizational knowledge; and 3) control training with shallow organizational knowledge.

Because of an interest expressed by some members of the Systems Engineering faculty at the Academy in the impact of spoken versus written messages, we also varied the type of messages that were sent out. In each of the three experiment conditions, half the subjects received all messages in written format. The other half received about 60 percent of the messages in the written format and about 40 percent as oral messages.

2.2.6. Participants

Thirty-six upper class cadets at the Military Academy at West Point participated in the experiment. The cadets participated in conjunction with a systems engineering class in which they were enrolled. Three classes of students were involved and the students were assigned to treatment condition by class. One class of 16 students received the IM training program and the deep organizational knowledge materials. A second class of 11 students received the IM training program and the shallow organizational knowledge materials. A third class of 9 students received the control training and the shallow organizational knowledge materials.

2.2.7 Procedure

Three experimenters were involved in the training and evaluation. They conducted all aspects of the training program and administered all written and oral questionnaires during the evaluation. One of the three served as the primary trainer who conducted the lecture portion of the training program. The three experimenters each conducted one of the three demonstration segments. Three instructors in the systems engineering department supported the conduct of the experiment by serving as controllers. Their duties involved role playing other nodes in the organization by responding to questions that participants posed in their electronic messages, listening to the subjects' oral situation assessment briefings, and assisting the primary experimenter in handing out and collecting forms and questionnaires to the subject.

Because the amount of time available for experiment sessions was limited, some materials needed for the training evaluation were distributed ahead of time. Participants were given the background scenario materials and the materials describing the organizational structure one week prior to the training evaluation. These materials included background information about the situation that set the stage for the particular situation used in the experiment, and information about the organizational structure in which they would be working. For the materials associated

with organizational structure, two classes of students received the materials associated with shallow knowledge of organizational structure and one class received the materials associated with deep knowledge of organizational structure. All participants were asked to carefully read and review all materials they received before participating in the experiment session. They were also asked not to discuss the materials with anyone else until the entire experiment was completed.

The conduct of the training and evaluation experiment was carried out over three class periods. In the first class period, after the trainer had introduced herself, all students completed the Organizational Knowledge Questionnaire designed to assess their level of knowledge about the organization. They also signed a consent form indicating their willingness to participate in the experiment. The remainder of the class period was devoted to the lecture portion of the training. The trainer presented the training concepts, and the students followed along in a specially prepared booklet. Two of the three participating classes received the IM training program. The third class received the control training. At the end of the class hour, the trainer provided a preview of the activities that would occur in the second class period.

The second class period was used for the demonstration portion of training and for training in the use of the scenario generator to be used in the experiment. During the demonstration segment of the training, which took approximately half of the 50-minute period, a trainer discussed with the students example situations that illustrated the concepts covered in the lecture portion of the training. For example, the demonstration materials showed examples of appropriate ways to handle messages that, while important in a real-world context, did not bear upon the subject's mission.

Following the demonstration, which occurred in the regular classroom, the trainer then handed out the "op order" which explained the current situation for the scenario and gave tasking to the Force I commander. The students were urged to read it over carefully before the third class

period. The students were then directed to the systems engineering computer laboratory, where they received training on how to use the messaging software that would be used in the experiment for receiving, reading, rating, and sending messages. One of the experimenters explained the processes that were involved to the students, who were then given an opportunity to try out the software and to ask any questions they had about how to use it. Before departing students were given instructions on how to fill out the Task Load Index (TLX) questionnaire that would be administered at the end of the experiment trial. They were also given a brief overview of the plan for the third class period during which the evaluation of the training was to be conducted.

On entering the laboratory for the trial assessing the effectiveness of the training program, participants sat down at one of the terminals and were introduced to the member of the experiment team who would serve as the controller for them. Their attention was also directed to a large map of the geographic region in the scenario. There were three maps mounted on easels in the front, middle, and back of the room to make them easily accessible to the subjects during the experiment trial.

One of the experimenters then gave a brief capsule review of the scenario, and gave the subjects instructions on what they needed to do during the experiment trial. Subjects then received written information about the vignette associated with the trial. The vignette introduced the specific mission in which the subject was playing and the subject's information processing task. Once the background information for the vignette was given, the message processing system was started and incoming electronic messages started to arrive.

Figure 2-6 provides a high-level overview of the experiment design and procedure. The experiment trial, itself, lasted 30 minutes. During the experiment trial, subjects had the capability to read, save, delete, list, and send electronic messages, either to transfer information to nodes more equipped to deal with a received message or to request information from another node in the

organization. Subjects in the experiment played the role of a member of the Force I commander's staff. All other nodes in the organization were role played by a controller, who responded to participants' mail messages when appropriate.

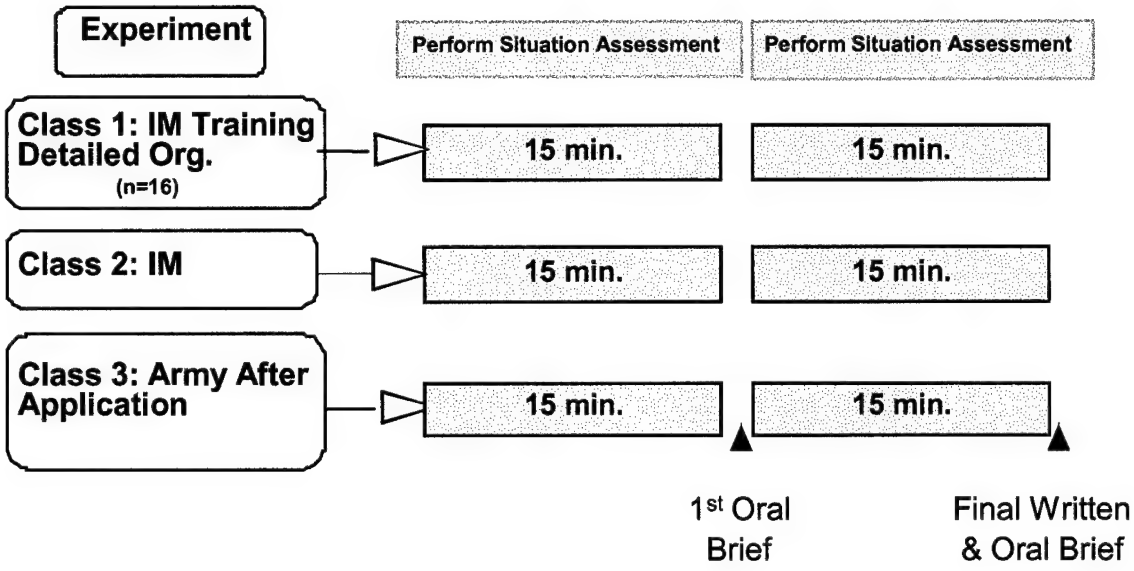

Figure 2-6. Overview of Experiment Design and Procedure

The experiment trial was divided into two 15-minute intervals. At the end of the first 15-minute period, the simulator was paused. At this time, participants responded to the four questions on the written briefing preparation form and then gave an oral briefing based on this written material.

After the interim data collection period, the simulation was resumed, with participants continuing to process messages and assess the situation. At the end of the second 15-minute period, participants completed a written situation assessment and briefed their assessment the situation to their superior, played by the controller. Participants were afforded more time to compose the final

briefing than the interim briefing. The two oral situation assessment briefings given by the participants were tape recorded. After the second time period, in addition to preparing and delivering a briefing, subjects completed the TLX workload questionnaire. They were then given the post-trial questionnaire and were asked to complete the questionnaire, and return it to the class instructor during their next regularly scheduled class period.

2.2.8 Dependent Measures

Performance Assessment

The major performance measures were derived from the periodic situation assessment briefings, or sitreps. Using the taped oral briefings and the associated written materials, a SME evaluated the participants on four aspects of their performance: 1) presence/absence of seven pieces of critical information, 2) overall written situation assessment, 3) overall written plus verbal situation assessment; and, 4) an overall situation assessment measure created by looking at the ratings of both the information pieces and the situation assessment.

Information-Processing Measures

Of the 76 message sent, 11 were determined by an SME to be mission critical. The remainder were considered mission nonrelevant. The number of mission critical and mission nonrelevant messages opened was computed as one assessment of information filtering. Participants were required to rate all incoming messages that they opened on a four-point scale with the following alternatives: irrelevant, non-critical, moderately critical, highly critical. For analysis purposes, message criticality was collapsed into two categories: noncritical (those rated irrelevant or non-critical by the participant) and critical (those rated moderately or highly critical by the participant). Messages not opened by participants were considered as having been implicitly rated as noncritical.

Participants were also permitted to send messages to different nodes in the organizational structure to ask for more information about the situation, or to forward messages they received to a node that they felt was more equipped to handle the information. Outgoing messages could be categorized according to the appropriateness of the destination, according to the hierarchical level (subordinate, lateral, or super) of the node to which it was sent, or according to its content.

2.3 TRAINING EVALUATION: RESULTS

In this subsection we discuss the results of the IM training evaluation. First we consider the impact of organizational knowledge and then the evaluation of the IM training program. We look at both the performance and the processing data.

2.3.1. Organizational Knowledge

We hypothesized that subjects in the deep organizational knowledge condition would have higher scores on the organizational knowledge questionnaire than those in the shallow condition. Based on the subjects' responses to the Organizational Knowledge Questionnaire we found no difference between the two organizational knowledge conditions. It will be recalled that the organizational knowledge booklet was handed out ahead of time to be read by the participants before the start of the first training session. We concluded that most of the participants in the deep organizational knowledge condition looked at the organizational chart and associated high level materials, but did not devote time to the details in the booklets that were provided. As a result, what they actually looked at was similar to what the participants who received the standard organizational materials saw, and this similarity was reflected in the similarity between the two groups on their responses to the Organizational Knowledge Questionnaire.

Because there were no differences between the shallow and deep organizational knowledge conditions, we collapsed this variable for the analysis of the performance and processing results,

and focused on differences between the group that received the IM training and the group that received the control training.

2.3.2 Peformance Assessment

We hypothesized that the training program would enhance the trained subjects' ability to deal effectively with large amounts of information, including identifying critical pieces of information. We expected that this difference would be reflected in more complete and higher quality sitreps in the trained group than in the control groups. To assess the difference between the two groups we examined the SME's ratings of the subjects' sitreps. (The rating procedure is described in subsection 2.2.8.)

Contrary to our expectation we found no difference between the ratings of the trained and control groups' sitreps. Figure 2-7 shows the number of critical factors out of seven that the subjects correctly identified in their written briefing and the overall rating of their sitreps based on a 7-point scale. The differences between the two groups are not significant.

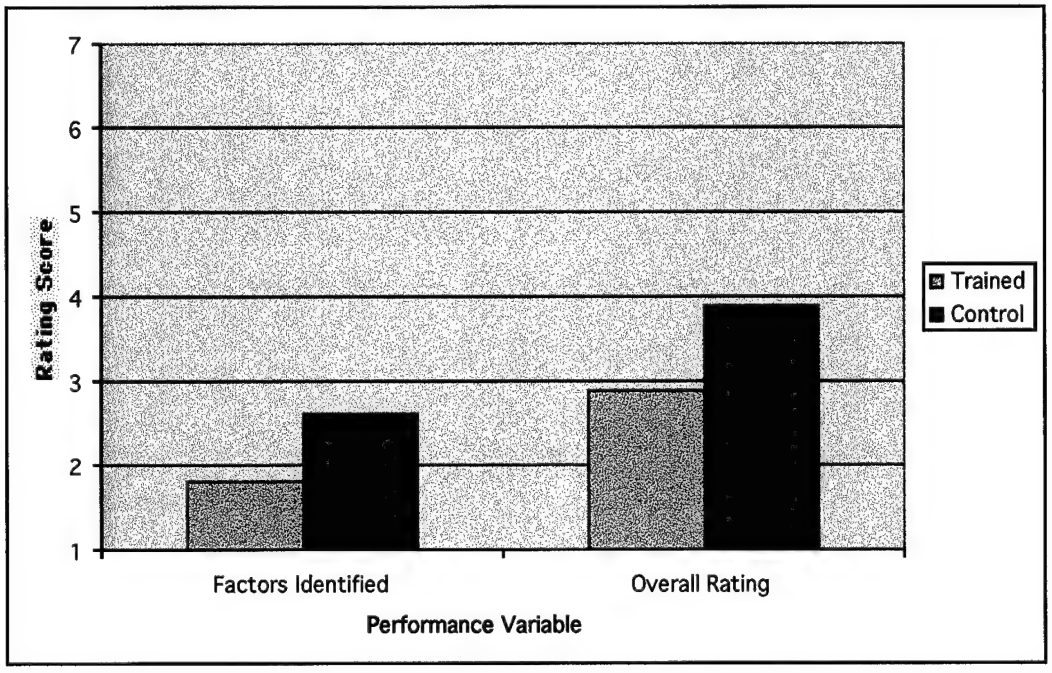

Figure 2-7 Performance Scores for Trained and Control Subjects

One of the striking points in Figure 2-7 is that the means for both groups are quite low. On the overall rating, a score of 1 means the subject has virtually no understanding of the situation and a score of 4 implies only limited understanding of the situation. The faculty members who supported the experiment commented to us that the scenario was quite complex and perhaps over the heads of the cadets. When they were doing their sitreps, many of the subjects commented that they were totally lost. The low mean values on the performance variables support these assessments. We concluded that the difficulty of the scenario and the problem posed in the vignette may have prevented the trained subjects from using what they had learned in an applied context.

As another exploratory approach to assess the impact of the training, we identified a small subset of the sample who evidenced some ability to deal with the complex scenario. These were subjects who had an overall sitrep rating of at least 5 (which corresponded to a qualitative rating of adequate to good). There were seven subjects who met this criterion, four trained and three control. We examined their scores to see if there was any evidence for the effectiveness of the training in this group, but found none. The mean sitrep rating (5.3) was the same in both groups, and the mean number of critical factors identified was virtually the same in both groups (3.8 for the trained and 3.7 for the control subjects). We conclude from this analysis that either the training was not strong enough for participants to be able to apply it to a problem situation or, even for the somewhat more able students, the problem complexity masked any training effects.

2.3.3 Information Processing

In this subsection we explore differences between the trained and control subjects in their information processing behavior. We hypothesized that the trained subjects would have a clearer focus on their information requirements and information sources, and this would make them more

effective in high level filtering of messages. To evaluate this hypothesis we compared the two groups in terms of which messages they opened.

We looked first at a comparison between messages received from another node in the organization versus messages received from external sources, such as media or other civilian groups. Figure 2-8 shows the proportion of messages from internal and external sources opened by the trained and the control subjects. The nature of the external sources suggests that their messages would not contain critical mission information. The results show that while the control subjects opened the same proportion of messages from within and outside the organization, the trained subjects opened a lower proportion of the messages from external sources. The result provides some confirmation for our hypothesis that trained subjects were more effective at high level information filtering.

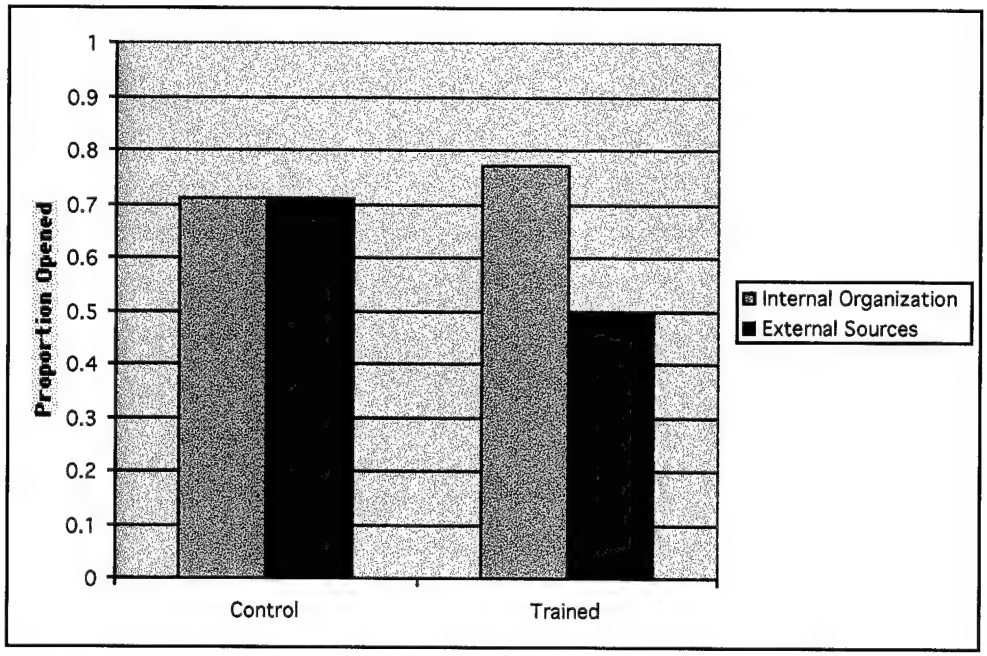

Figure 2-8. Control and Trained Subjects' High Level Filtering by Message Source

As a second way of looking at high level filtering, we examined filtering based on the subject of the message. We categorized the message topics into two groups: those that were

clearly not relevant to the subject's mission and those that were potentially relevant. Figure 2-9 shows the proportion of messages of each type opened by the trained and the control subjects. The figure shows while both groups opened a smaller percentage of nonrelevant than potentially relevant messages, the trained group opened more potentially relevant and fewer nonrelevant messages than the control group. This result provides further evidence that the training program enhanced participants high-level filtering ability.

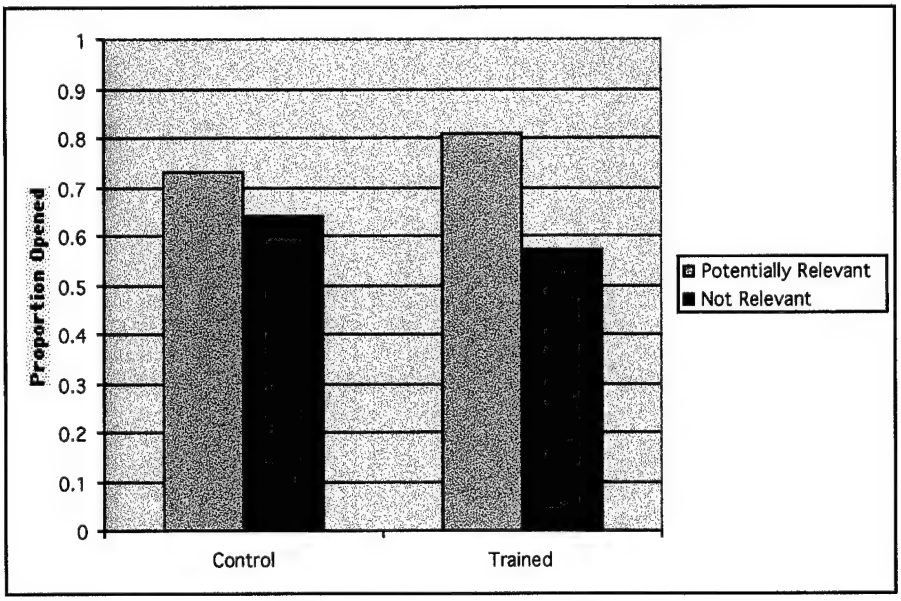

Figure 2-9. Control and Trained Subjects' High Level Filtering by Message Subject

High level filtering relies only upon information in the message header. When the information in the message header suggests that the message may contain information relevant to the mission, the information processor must open and examine the contents of the message to make a more informed decision about its relevance. To help individuals assess the relevance of messages they read, the *Specify* step in the MISSION mnemonic suggested that individuals should specify ahead of time the information they are seeking, and the *Ignore* step reminds them to ignore

information that is not relevant to their mission. This training should help individuals more accurately assess the relevance of a message to their information needs.

Subjects rated messages they opened on a 4-point scale, where 1 was not relevant at all and 4 was critical. Figure 2-10 shows the control and trained subjects ratings of internally and externally generated messages that they opened. Both groups rated the relevance of external messages below that of internal messages. The difference between the two types of messages was greater for the trained subjects than the control subjects, but the interaction was not significant.

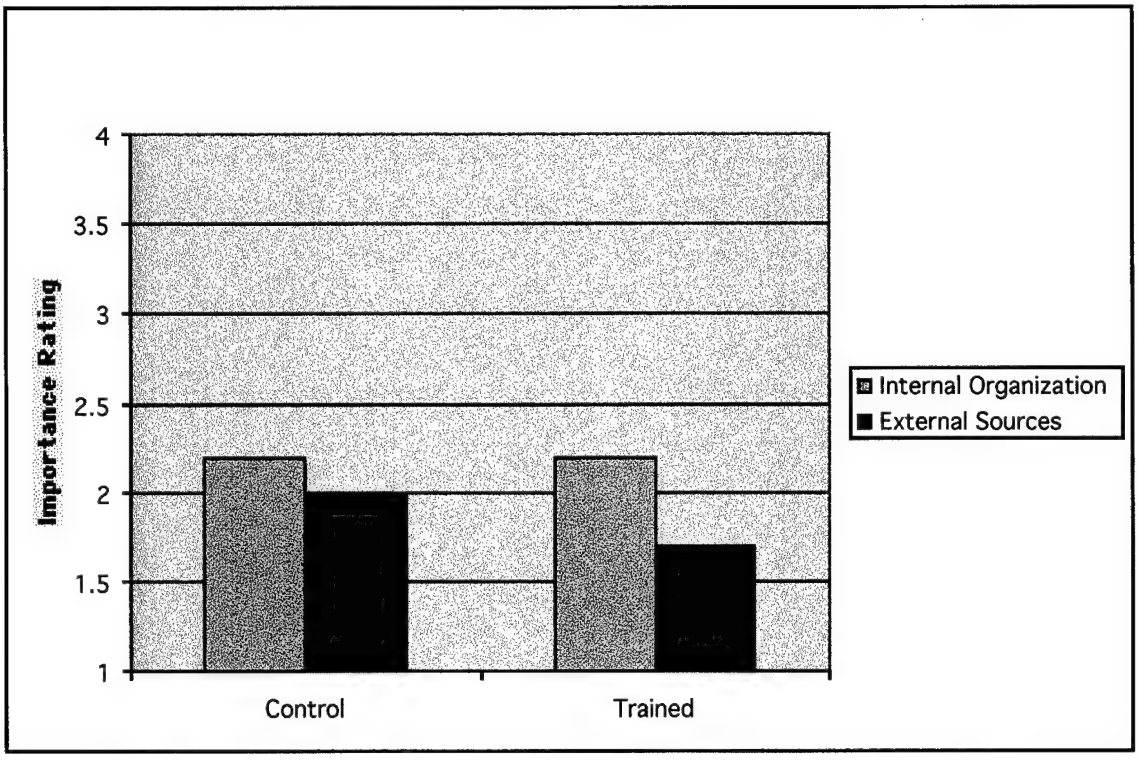

Figure 2-10. Control and Trained Subjects' Message Evaluation by Source of Message

Figure 2.11 shows a similar comparison for message relevance. Trained subjects rated potentially relevant messages higher and nonrelevant messages lower than control subjects, but the interaction between training and message relevance was not significant. We assessed whether the trained subjects were more accurate in differentiating between critical and noncritical

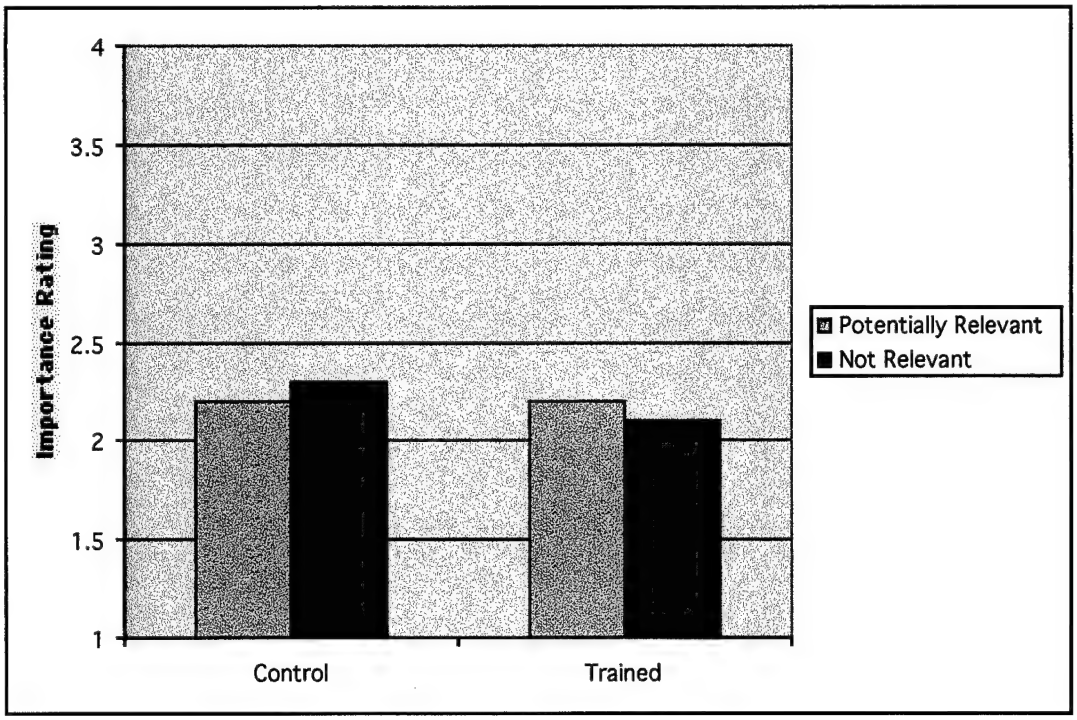

Figure 2-11. Control and Trained Subjects' Message Evaluation by Relevance of Message

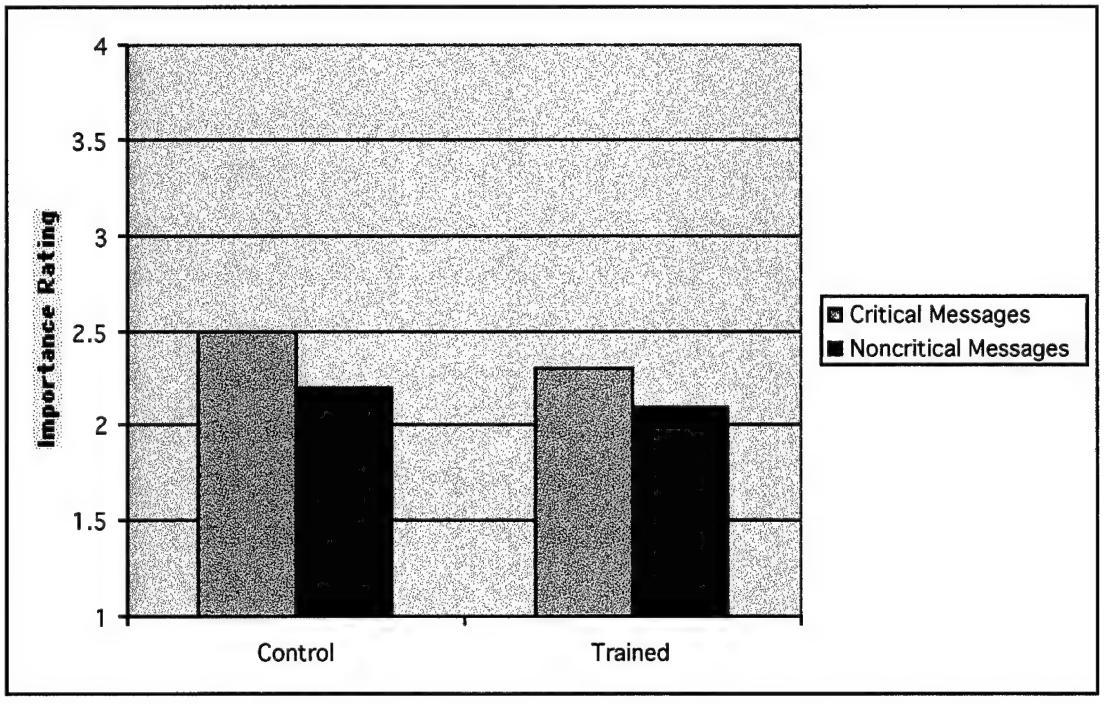

Figure 2-12. Control and Trained Subjects' Message Evaluation by Criticality of the Message

messages than the control subjects. All subjects rated the critical messages higher than the noncritical ones, but, as Figure 2-12 shows, there was no difference between the two groups.

2.3.5 Message Modality

Half the subjects in each experiment condition received all messages in a written format. The other half received approximately 40 percent of the messges in spoken format and the other 60 percent in written format. We examined the information processing results to see if there was any difference between the two groups on this factor.

We found no difference between the two groups in their performance. We also looked at the measure of workload to see if message modality impacted the subjects' perceived workload, but found no difference between the two groups on this measure either.

For the subjects who received both spoken and written messages, we compared their rating of the importance of the messages to see if message modality impacted their assessment of its importance, but found that the mean importance ratings were about the same. We also computed the amount of time subjects kept messages open to see if the message modality impacted processing time. On average the subjects kept a message open for 30 seconds, and the mean for both written and verbal messages were not different by more than one second.

2.4 TRAINING EVALUATION: DISCUSSION

2.4.1 Summary of Results

Our main focus in the analysis of the data from the training program evaluation was on exploring differences in performance and message processing between the trained and the control groups. We hypothesized that the IM training program would make participants better information managers, better able to identify, evaluate, and comprehend incoming information, better able to

recognize information gaps, and more knowledgeable about where and when to seek missing information.

We found no difference between the two groups on their information processing performance, as reflected in their sitreps. We did find that for all groups, the performance ratings were low, with few subjects even reaching the level of satisfactory performance.

We concluded from the performance results that the scenario materials we used to test the effectiveness of the training program were above the experience level of the cadets who participated in the training evaluation. Given this situation, it is not possible to ascertain whether the observed performance resulted because training did not have an impact on performance or whether our ability to detect any effect the training may have had was hampered by the scenario we used. The finding that even among the higher-performing subjects there was no discernable difference between the trained and control groups suggests that any effect the training had on performance was at best weak. We concluded that information comprehension and integration is an area that required strengthening in a subsequent version of the training program.

We did find that the training had an impact on the subjects' information processing behavior, as reflected in their ability to filter messages before opening them. We found that the trained subjects were more effective in high level filtering than were the control subjects. They opened fewer messages that were not likely to be relevant to their mission. For messages that subjects opened, the impact of the training on their ability to identify critical messages was less clear. Although trained subjects differentiated important from nonrelevant messages somewhat better than control subjects, the differences we observed were not statistically reliable. We concluded that the training program seemed to be oriented in the right direction, but was not strong enough to support reliable differences in subjects' ability to discern critical information in messages they open.

2.4.2 Implications for Training Program Enhancement

Data were collected from a number of sources to evaluate the training program as it was implemented at the Military Academy and to aid in the further development of the Information Management training. The sources included data collected during the experiment; comments collected from the participants in the training program and the faculty members who were involved in the experiment; and experimenter observations. These sources revealed a number of ways in which the training program could be enriched, modified, and extended. Among the important conclusions reached are:

- **Integrate organizational knowledge training into IM training program**

  In the preliminary version of the training program we stressed that information managers need to be aware of the organization in which they are working, including the kinds of information likely to be available at different nodes in the organization. However, it did not explicitly incorporate organizational knowledge into the training package. Rather, a booklet describing the particular organization used for evaluating the training program was distributed to participants to be read before they arrived for training. Data collected from the participants revealed that they did not read the booklets before the experiment, and since the contents of this booklet were not specifically related to the training program and were not explained verbally in any way, the participants did not achieve the level of organizational understanding needed for effective information management. They were not motivated and/or able to apply the information described in the organizational knowledge booklets. Given this evidence, we concluded that distribution of written materials is not a dependable way to convey organizational knowledge. Rather, training on organizational knowledge should be directly integrated into the IM training program. This training would emphasize the importance of

organizational knowledge for effective information management, both in terms of information seeking and information distribution.

- **Explain causes and consequences of information overload to motivate training**

  Data collected from the participants and faculty suggest that the participants lacked the motivation needed to stimulate learning in a training situation. Although most people have experienced information overload, fewer are aware of how they themselves contribute to situations of information overload. Likewise, though many people relate situations of information overload with feelings of stress, fewer are aware that overload can degrade cognitive processing. We concluded that one effective way to motivate the training program would be to explain how individuals can unwittingly contribute to information overload, for example by indiscriminately forwarding electronic messages. A second way to motivate the training is to explain how overload impinges on different aspects of cognitive processing, for example by narrowing an individual's focus of attention and by decreasing vigilance. We felt these motivating factors would be especially helpful in sensitizing people to the ways in which they might contribute to information overload and its impacts on their cognitive processing and behavior.

- **Put a strong emphasis on behavioral training**

  In addition to revealing a motivation problem with our participants, our data also suggested that the training focused too little on actual behaviors that should be used for proper information management: Participants were still unsure HOW to properly manage information. In the preliminary version of the training program we used the elements of the MISSION mnemonic as the basis for training. The data showed some indications that the program was effective in making participants better at high level filtering, but we had at best weak evidence we were successful in improving participants' second level, or content,

filtering. We concluded that the training approach may have been too conceptual, without showing how these conceptual ideas could be behaviorally implemented. We decided that the next version of the training program needed to incorporate particular information processing skills that participants can use. In particular, the program needed to stress active preparation of information requirements, scanning for key words and phrases as a technique for evaluating the relevance of incoming information, and writing of succinct messages that only contain information relevant to the intended receiver.

- **Include all components of effective training**

  An effective training program, such as the successful Team Adaptation and Coordination Training (TACT) Program (Entin and Serfaty, 1999), includes four components: lecture, demonstration, practice, and feedback. In the preliminary version of the training program the demonstration material was packaged as a written document, and appeared to be another facet of the lecture component. We concluded that an effective demonstration component needs to be more dynamic, and to rely on examples acted out in a specific context, for example by incorporating video clips that portray examples of inappropriate and appropriate information processing behaviors. Furthermore, due to a limit on the amount of training time that was available, we did not include practice and feedback components into the preliminary version. From the data collected, it was clear that the lack of opportunity for participants to practice the concepts and behaviors that were covered in the lecture and demonstration components limited their ability to internalize the material that was covered. We concluded that even with improved lecture and demonstration components, the effectiveness of training is weakened without the opportunity for participants to apply the concepts and receive feedback on whether they are applying them appropriately.

- **Enhance and ensure sensitivity of training evaluation**

  The finding that the scenario and task we used to evaluate the training program was too complex for the participants in the training program weakened our ability to draw conclusions about the effectiveness of the training. It emphasized the need to insure that the scenario and task are calibrated to the trainees' level of experience. It also alerted us to the need to insure that the examples used in the training program are realistic and at a level appropriate for the individuals who are being trained. Furthermore, in the course of analyzing the data from the training evaluation, we realized that the sources and subjects of the messages used were too limited, and that we needed to have a greater range of sources and subjects both in the messages used for the training component and for those used in the evaluation of the training. We also concluded that the information about time messages were generated was not salient, and in so far as time is a factor that is considered in information filtering, the message time needed to be made clearer.

- **IM training should build on the training already experienced by the military personnel**

  The preliminary version of the training program was a stand-alone-training program; although the examples used were military in nature, no consideration was given to the decision making training delivered to military personnel. This approach resulted in training that was at times redundant to, and at times conflicting with, the training the personnel already receive. Because the participants were cadets, whose military training was just beginning, any inconsistencies that might have existed were not evident. However, to make the training more effective for experienced officers, and to capitalize on the training already received by the military personnel, we consulted with an SME who suggested that the training should be revised in such a way that it would integrate more seamlessly with the Military Decision Making Procedures (MDMP) that officers are taught.

Based on these conclusions, we worked in conjunction with an SME to develop and implemented another version of the IM training program. We applied and evaluated this improved version with participants from the Battle Command Battle Laboratory at Fort Leavenworth, KS. We describe the improved program and the evaluation that was conducted in the next chapter.

CHAPTER 3

INFORMATION MANAGEMENT TRAINING PROGRAM: DEVELOPMENT AND EVALUATION OF THE TEST VERSION

In this chapter we discuss the enhancement and restructuring of the preliminary information management (IM)training program and the evaluation experiment that we conducted to assess the effectiveness of the revised training program. We refer to this upgraded version of the training program as the Test Version.

3.1 DEVELOPMENT OF THE TEST VERSION

3.1.1 Modifications and Enhancements to Preliminary Version

Focus Restructuring

The preliminary version of the training program featured a mnemonic, "MISSION" to convey the substantive points of the training, particularly the need to identify and focus on critical elements of information. Emphasis was placed on preparation, including information requirements, information sources, and time constraints for obtaining information. Less emphasis was placed on how to apply this knowledge to specific information needs. In the Test Version we used a different approach. Although the "MISSION" concept seemed appropriate for the target audience who received the preliminary version of the training program, our subject matter expert (SME) advised us that the word "mission" has very specific connotations for military officers, and the way in which we were using the term might seem confusing or inappropriate to them. He also advised us that the approach we used needed to be consistent with military training that officers have received, and that we needed to show where it fit in terms of the traditional Military Decision Making Process (MDMP) that officers learn.

Another reason why we moved away from the "MISSION" concept is that we concluded that the training needed to focus on specific information processing behaviors as well as stressing

the importance of determining information requirements. That is, it needed to address techniques that can be applied to deal effectively with incoming and outgoing information in a dynamic information processing situation.

Because military officers might assume that the military had already given them all the IM training that they would need, we wanted to highlight the need for additional training to motivate the subjects to attend to the training. We did this by framing our discussion in the context of how the MDMP is an excellent process to follow when faced with decision making situations, and how this new training supplements the MDMP by giving trainees specific behaviors that they can use to make the MDMP work. To further motivate trainees, we discussed the adverse impacts of information overload and the degradation in cognitive processing that can result from information overload.

Another conclusion from the evaluation of the preliminary version was that organizational knowledge needed to be folded in as a component of the IM training. Giving participants long manuals on the organizational structure and channels of communication to read on their own proved to be an ineffective way to provide organizational knowledge. For the Test Version we incorporated training about the importance of knowing the organization for effective information management directly into the IM training program.

Training Components

The preliminary version of the training program was comprised of two components: lecture and demonstration. The demonstration portion consisted of a discussion based on written examples of ineffective and effective information management. In administering the program, we noted that the written examples, though substantively adequate, were rather 'flat' when they were presented as text. A more effective technique, we concluded, would be to make these examples more salient and more credible by having them acted out. In the Test Version of the training

program, we created a demonstration videotape, in which ineffective and effective IM techniques were exemplified. Entin and Serfaty, (1999) used this approach successfully in a training program they developed.

Due to limitations on the amount of time available for training, we did not incorporate the practice and feedback components of training into the preliminary version. The lack of opportunity for the trainees to apply the concepts discussed in the lecture and demonstration portions of the training emphasized the importance of the practice and feedback components. For the Test Version, we developed a specific training scenario that allowed subjects to practice the concepts that had been covered in the lecture and demonstration phases of the training. Feedback on performance could go hand in hand with practice.

3.1.2 Description of the Test Version of the Training Program

The Training Program was comprised of the four components needed for effective training: lecture, demonstration, practice, and feedback. The lecture portion was conducted by the trainer, and was organized around a set of slides that set the context of the training, provided motivation for it, and discussed the training concepts and techniques that we had developed. We used the initial portion of the lecture component of the training program to convey how the IM training we provided fit in with previous military training and to motivate the need for effective IM skills.

We wanted to make it clear at the outset of the training that it builds upon and supplements, and is not a repetition of or replacement for, the information processing training that Army officers have already received. The trainer used the diagram shown in Figure 3-1 to provide an overview of the training program and show how it fits into the Army's Military Decision-Making Process (MDMP). Figure 3.1 also provides an overview of the key information processing techniques presented in the training program.

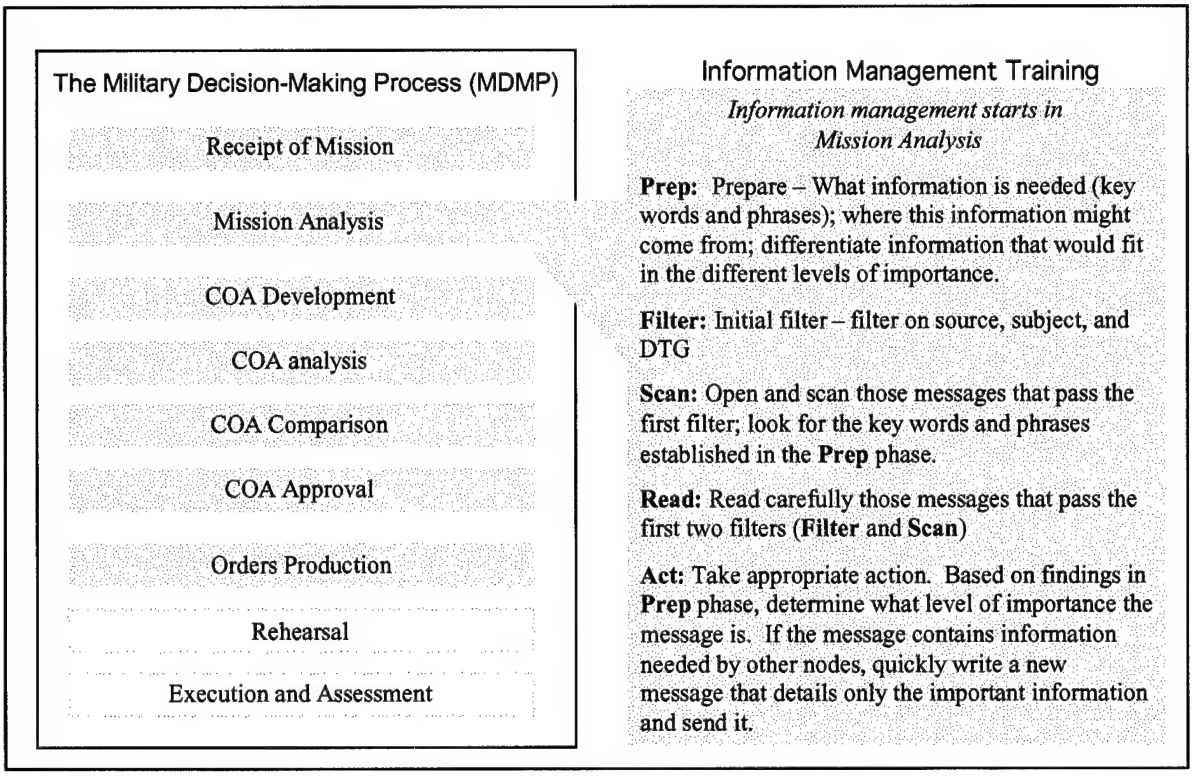

Figure 3-1. Relationship of Information Management Training to MDMP and Key Information Processing Techniques

Once we established the context for the training program, the trainer turned to a discussion of what information overload is, why it occurs, and what are the cognitive and psychological results of information overload. With this contextual and motivational basis established, the lecture went on to discuss the techniques portrayed in Figure 3-1 (prepare, filter, scan, read, act) in detail, using several illustrative scenarios. Examples of effective and ineffective applications of these techniques were provided in the context of the illustrative scenarios.

The demonstration portion of the training program centered around videotaped examples illustrating less and more effective IM techniques. The examples presented were based upon a scenario in which an officer needed to monitor email traffic to determine whether and how units could get around a wadi. The videotape examples showed someone handling information in a less than optimal way, and then showed the same person doing a more effective job. After each

segment the trainer stopped the tape and discussed the contents with the trainees. Examples were provided for each of the techniques discussed in the lecture portion, starting with identifying information requirements, high level filtering, information scanning, and information distribution.

In the practice and feedback portion of the training, the trainee was given a role as an assistant battle captain whose task it was to monitor email traffic to determine why an armored column had stopped along a road. Before the vignette was described to them, participants were given a Preparation Sheet on which they could make notes about information requirements as the vignette was described and as the scenario unfolded. A trainer sat with the trainee as he or she processed the email messages, answering questions the trainees had about the contents of the messages, and providing some feedback on their message processing actions. The practice also allowed subjects to become acquainted with the features of the simulator we were using, and the requirement for rating both incoming and outgoing messages.

3.1.3 Description of Control Training

In order to assess the effectiveness of the training program, we needed a control group against which to compare the trained group on an IM exercise. The control group received training on the Objective Force. It was explained that the scenario they would be participating in was set in the future (2008), and since allied forces were joint, some background on the vision for the Objective Force would set the stage for the exercise.

The lecture portion for the control portion was somewhat longer than the IM training lecture component, and was followed by a discussion between the trainer and trainees. The control training did not contain a demonstration segment. Following the lecture and discussion, the control subjects went into the practice and feedback portion of the training. The procedure was similar in form to that used for the IM training subjects, except that feedback did not include guidance on the manner in which the subjects were processing the email messages. The control

trainers did answer factual questions subjects had about the scenario, and any questions they had about use of the email application.

3.2 TRAINING EVALUATION: METHOD

3.2.1 Scenario Materials

We used the same scenario materials that were used for Experiment 1 and for the assessment of the preliminary version of the IM training program. They were modified by an SME to make them more consistent with Army doctrine and practice and to make the force organization clearer. The scenario portrays a Joint mission situation set in 2008. The basic situation is that Country A's troops have invaded Country B, and a Joint Coalition Force, Task Force Agile, led by the United States, has been authorized to restore Country B's borders. After 12 days of attacks against Country A's forces, intelligence estimates indicate that its air, missile and naval forces in Country B have been largely destroyed and communications capabilities crippled. Based on these estimates, the commander of Task Force Agile has just determined that Phase I of the campaign has been successfully completed, and has ordered execution of Phase II. The two vignettes that were used for training practice and for training evaluation stemmed from this basic scenario. The following sets of materials were used to portray the scenario:

Background Situation (Road to War).

This document provided a description of the background situation, including how and why the Country A's forces were in Country B, the composition and disposition of Task Force Agile, and the coalition plans for routing the Country A's forces. It describes the makeup of the coalition forces, and outlines the activities that have occurred under Phase I.

Oplan

The Oplan consists of the mission, commander's intent, the concept of operations from Phase I to Phase V, and a more detailed plan for Phase II, in which the vignettes are set. It also includes a partial intelligence annex and operations graphics.

Intelligence Annex

This Annex describes the enemy laydown. It was not deemed highly relevant for this mission but was included for the sake of realism and completeness.

Situation Update

This one-paragraph document brings the situation up to the current time in which the two vignettes are set. It states that Phase I of the operation has been successfully completed, and the Commander of Task Force Agile has authorized the start of Phase II.

Training and Data Collection Vignettes

Working with a SME, we developed two vignettes, one to be used for the practice component of the training and the other for the training evaluation. Both spin off from the basic scenario. Both vignettes were designed to be interesting to and at a suitable level of difficulty for mid-career Army officers. For both vignettes, the subject played the role of an assistant operations officer in one of the forces comprising Task Force Agile. The subject's task was to monitor message traffic and assess an evolving situation. For each vignette we provided a communications chart showing the primary and secondary communications linkages in the organizational structure.

The vignette used for training was adapted from one we had used previously to make it more Army-oriented. In the training vignette the participant, playing the role of battle captain, is charged with the task of determining why an enemy armored column has stopped in an area in which Blue intended to land troops by helicopter as part of a forced insertion. The battle captain is

told that at the "eleventh hour" a humint group on the ground reports that an armored column of tanks and other armored vehicles has halted in the intended drop zone. The battle captain is charged with the task of monitoring the information traffic and determining the intent of the enemy armored column. In particular, have they compromised Blue's plans and intend to defend the area? Are they reinforcing other units in the area? Have they stopped for some other reason?

In the data collection scenario the participant, playing the role of battle captain, is asked to determine if an enemy mechanized division is heading toward or away from the area in which Blue plans a forced insertion. The battle captain is told movement has been detected in an enemy division. The task is to monitor the information traffic and determine the direction in which the mech force is moving. Blue's intel officer provides three plausible enemy intentions: the division is moving to the north in response to Blue's deception to convince the enemy that the invasion will occur in the north. This is considered most likely and favorable for Blue in that it indicates the enemy has bought into the deception and is moving its division too far away to oppose Blue's forced insertion. A second possibility is that the enemy division is moving northeast to a sea port. This is also plausible and far enough away from the planned insertion point to not foul Blue's plan. The third alternative, the most dangerous for Blue, holds that the enemy division is moving south into the general area of the forced insertion. This would mean Blue would have to suspend its current plan and turn to an alternate. Based on the email traffic contained in the scenario, the battle captain must determine which enemy alternative is most likely and report back to his commander in his sitrep.

Maps

We provided each subject with an ONC (1:1,000,000) map opened to the area in which the scenario is set. Overlaid on the map was a hand-drawn overlay which portrayed relevant locations of Task Force Agile units and a sketch of the general plan for the Phase II operation.. For

each of the vignettes, we provided a hand-drawn overlay that showed the force distribution specific to that vignette.

Messages

For each vignette, the dynamic scenario was described though a set of messages that portray an evolving situation stemming from the vignette descriptions. Each message was categorized by the SME who developed the vignette in terms of its importance for the mission described in the vignette. The importance level of the email messages was determined by the SME who developed the data collection vignette. *Critical* messages were those that were necessary for understanding the evolving situation. They pertained directly to the commander's critical information requirements (CCIRs). *Relevant* messages supported understanding of the situation, but any single message did not, in and of itself, convey information that was crucial for understanding the situation. *Nonrelevant* messages, although they might be important in some other context, were not related to the subject's mission. Appendix B contains examples of the three types of messages.

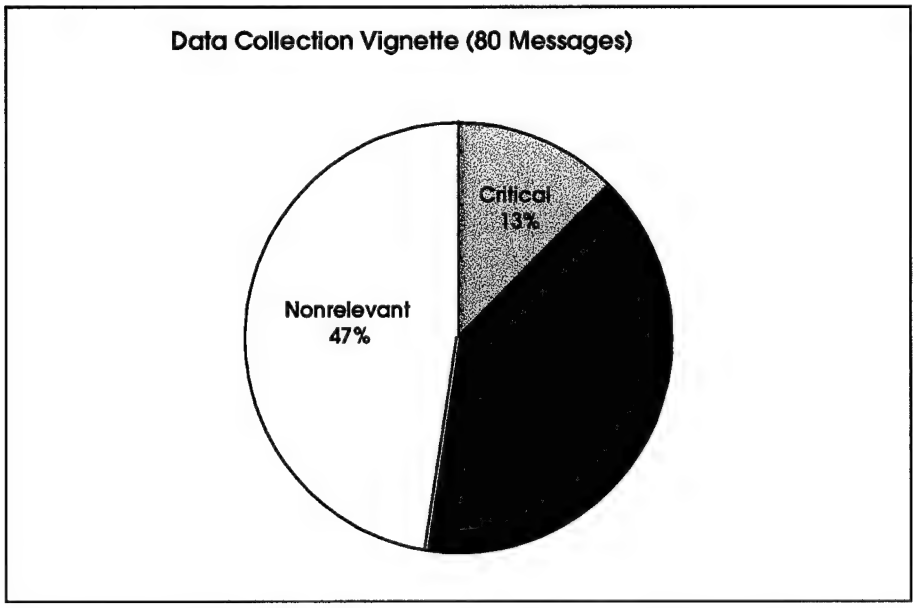

Figure 3-2 Distribution of Importance Ratings of Messages in Data Collection Scenario

In developing the message stream, the goal was include more and less relevant messages in a ratio similar to what might occur in a real world situation. Figure 3-2 shows the distribution of importance ratings for the 80 messages in the data collection scenario.

3.2.2 Scenario Generator

The simulator used for the training program evaluation was a tailored version of a standard email application, similar to the one used at the Military Academy in the evaluation of the preliminary version of the training program. It allows an experimenter to set up a file of pre-planned messages, and send the messages at specified times after start of scenario execution from a 'controller' machine to a 'subject' machine. It also allows both the controller and the subject machines to reply to messages, forward messages, and generate new messages at any time during the execution of the scenario. It logs both the subject and the controller message processing actions in a message file, thereby providing a record of which messages were opened, the times they were opened and closed, and the ratings of the messages. It requires the person at the subject machine to rate the importance of all messages that are read and all messages that are sent.

The following subsections describe the system and hardware requirements for running the scenario generator, the modifications we made to the initial version used in the evaluation at West Point, and a description of the interface for this upgraded version.

System Requirements

The software is written in Java™, using the Java Developers Kit 1.2.x (JDK™). It requires JavaBeans™ Activation Framework 1.0, JavaMail™ 1.1.3, and POP3 1.1. These are freely available from the Sun website, http://java.sun.com/products. The program runs on a PC running Windows NT™. It requires about 500kb of disk space to install, and several additional kilobytes of disk space to write the log files each time it is run. It requires access to a machine that can

function as a POP3 and an SMTP server. Two accounts are required on the server. An external program (such as Netscape or Eudora) must be used to remove messages from the server.

The software runs on a pair of machines. One machine functions as the controller, and sends a stream of preplanned messages at specified times. The other is the subject machine, which receives the messages.

Modification of Message Handling program

Several modifications and enhancements were made to the scenario generator for the Test Version. Key modifications that were made included:

1) Augmenting the log file of messages received by the subject to include ground truth priority and message generator (to differentiate preplanned messages from dynamically generated messages sent by the controller), and modifying the format of the file to make it more suitable for data analysis.
2) Changing the format of displayed message header to make it more legible and adding a "to" field to specify all recipients of the message.
3) Augmenting the log file of messages sent by the subject to include a new field indicating the type of message (reply, forward, forward with edits, new), and tracking which source message is being replied to or forwarded.
4) Creating a log file of messages sent by the controller, similar to the log file of messages sent by the subject.
5) Modifying the message ID to allow tracking of individuals messages when a "conversation" of replies takes place.
6) Developing scripts to simplify running of the program and data retrieval.

Scenario Generator – email program

The simulator delivered new email messages every 30 seconds. Each preplanned message was sent out at a predetermined time. With a total of 80 preplanned messages and a 30 minute scenario time, messages arrived at the rate of approximately 2.7 per minute. Given that messages were delivered in 30 second intervals, typically one or two messages arrived in each 30 second interval.

Figure 3-3 shows a sample email message window. Messages in black have not been opened; grayed out messages have already been opened. Figure 3.4 shows an example of an open message with the importance rating menu pulled down. In the figure, the subject has not yet selected the importance rating for the open message.

Subjects were able to reply to, forward, and generate new messages. These options are shown at the top of Figure 3-3. If a subject chooses reply, the original message appears in the box, and the subject can start typing a reply, with or without deleting the original message. If a subject chooses to forward a message, the original message appears in the box and the subject can send it as is, or modify and/or add to the original message. If the subject chooses new, an empty message box appears, and subject can start typing a message.

The subject had to specify the recipient of the messages, and a scrollable, pull down menu, shown in Figure 3-5, was available for that purpose. The last selection in the scrollable menu was 'all'. If the subject chose that alternative, the message would be sent to all nodes in the organization. Subjects were also required to rate the importance of any messages they sent out. The menu for importance rating of outgoing messages is below the Subject Line. It is also a pull-down menu. (In Figure 3-5 it is obscured by the list of message recipients.)

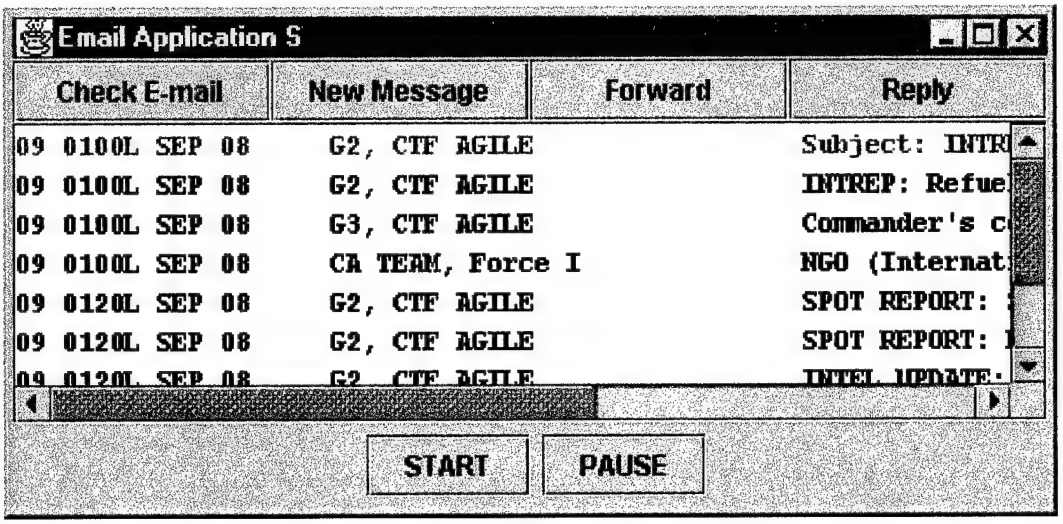

Figure 3-3. Sample e-mail Message Window Message Generation Options on Top

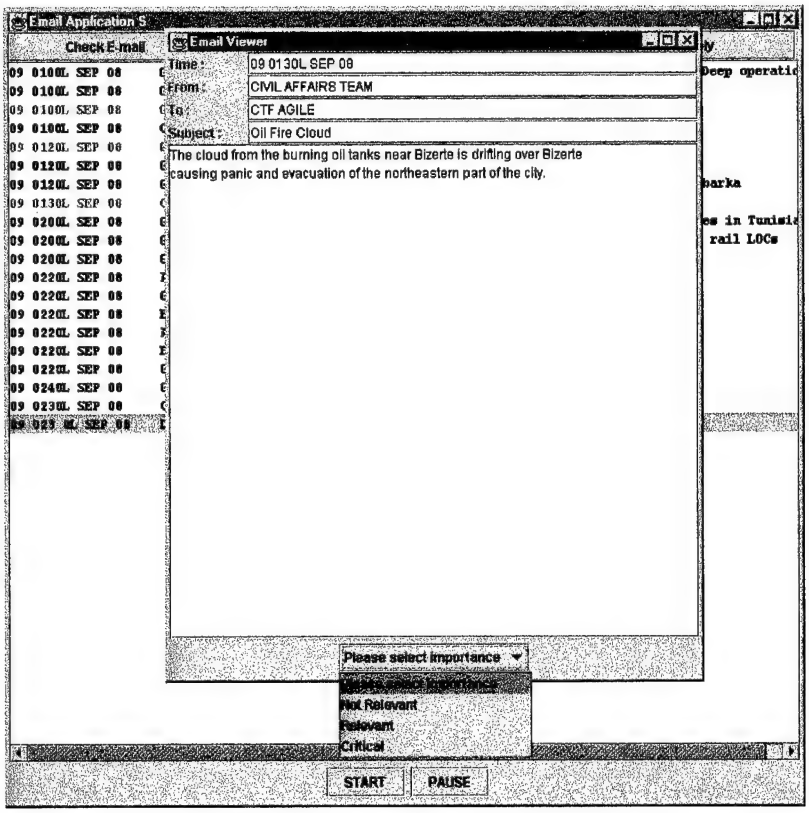

Figure 3-4. Sample email Message with Important Rating Menu

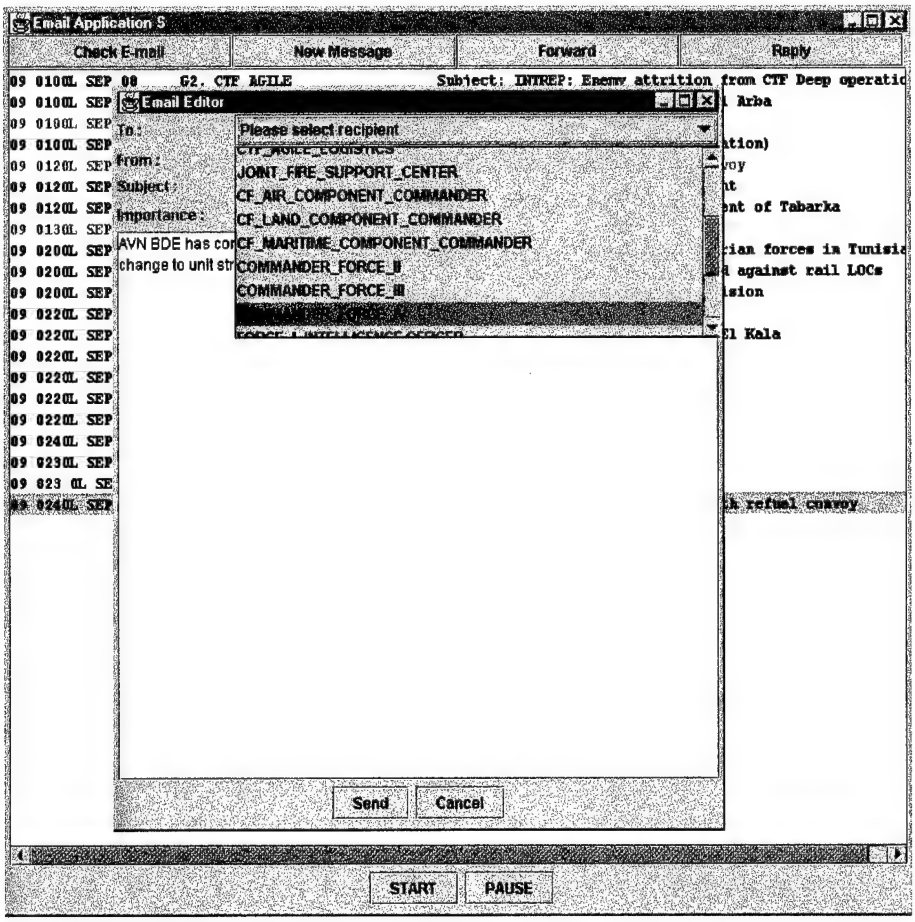

Figure 3-5. Scrollable List of Recipients for Subject-Generated Messages

All subject-generated messages were received at the controller's station, regardless of the node to which they were sent. If the controller chose to do so, he or she could reply to the subject's messages, for example to answer a question or to confirm a requested action. Controller-generated messages were sent back to the subject, and appeared in addition to the preplanned messages. The rate of message delivery was increased somewhat if the controller sent out messages. To retain uniformity in the substance of the message stream, the controller-generated messages were short and noncommittal. For example, if the subject-generated message was an action request, the controller might reply "OK", or "will do". If the subject's message contained a question, controller might reply something like "will check that out", or "not known at this time",

as appropriate. The goal was to give subjects some response so that they knew their messages were being read, but not add any substantive information.

3.2.3 Instruments

Five instruments were used during the training evaluation, all of which were completed by the subjects. (See Appendix B for copies of these instruments.)

The *Background Questionnaire* solicited information from the subjects about their military background, including their years of service, rank, and specialty. It also requested information about their recent military schooling and exercises in which they had participated. The Background Questionnaire was administered at the beginning of the experiment session.

The *Post-Training Questionnaire* was administered to assess the subjects' understanding of the material covered in the training program. It contained five short-answer questions, of which three were relevant to the training experience, and two were filler questions, one of which incorporated topics discussed in the control 'training'. This questionnaire was administered after the practice and feedback portion of the training.

The *Briefing Organization Form* helped subjects prepare their interim and final sitreps It included four questions about the information they would like to have, where they could obtain it, their current hypothesis about the situation, and how they thought it would evolve that subjects could use to organize their thoughts. Subjects were required to complete this form in preparation for the interim briefing. They were encouraged, but not required, to fill out the Briefing Organization Form to prior to giving their oral sitrep.

The *Briefing Preparation Sheet* was a single page of lined paper that could be used by subjects to take notes during the scenario preparation or message handling phase of the experiment. It was given to subjects prior to the start of the description of the training and data collection vignettes. Subjects were told they could use this paper to jot down any notes they wanted about the scenario.

The *Post Experiment Questionnaire* was a self-report measure that probed subjects' views about the comprehensibility of the scenario, their actions during message processing, and their overall evaluation of the training program. It was administered at the end of the experiment session, just prior to the subject debriefing.

3.2.4 Procedure

Three experimenters participated in the training evaluation. One experimenter served as the trainer for both the trained and control groups. A second experimenter presented all the scenario materials. These two experimenters also served as the controllers during the conduct of the training and data collection scenarios. A third experimenter conducted the training on the messaging system, and served as an experiment coordinator.

Figure 3-6 provides a high-level overview of the training evaluation design and procedure. Each session lasted approximately three hours, and was designed either as a 'training' or a 'control' session. Two subjects participated in each session. At the start of each session, an experimenter provided an introduction and overview of the session format. Subjects then completed the Background Questionnaire.

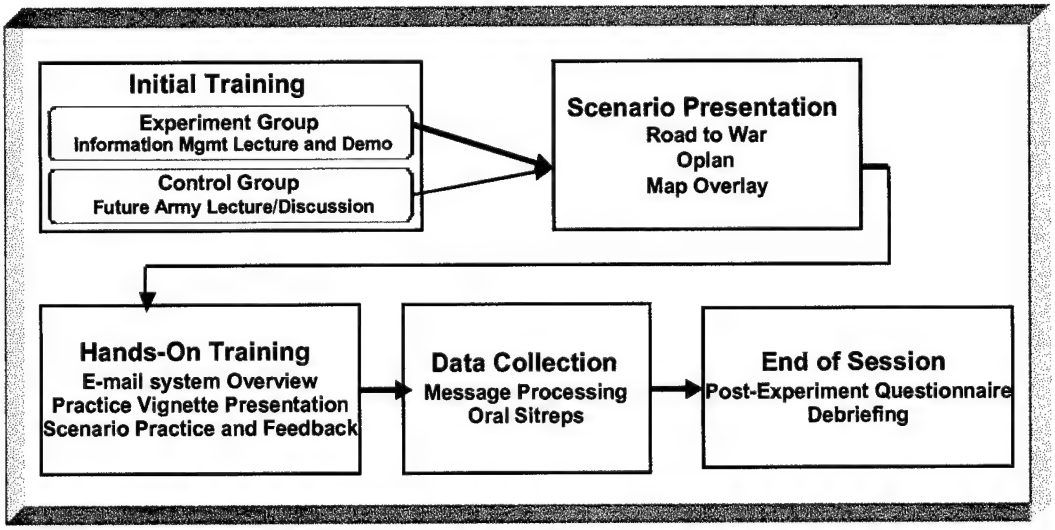

Figure 3-6. Overview of Experiment Procedure

The initial training was comprised of the lecture and demonstration (or discussion for the control group), and lasted approximately 40 minutes. The two subjects were trained together for this portion of the training program. Subjects in the training (i.e., experiment) group received the IM training materials. Subjects in the control group received the materials on the Army of the future.

Following the lecture and demonstration training, subjects were briefed on the scenario that would be used for both the practice and data collection portions of the experiment. The briefing included an overview of the background situation (The Road to War) and the commander's Oplan for Phase II of the operation, the phase in which both the practice and data collection vignettes were placed. Following that, subjects received a short introduction to the modified email system that served as the simulator. The major focus of this introduction was to apprise subjects of the message rating requirement. Then subjects read the scenario update, a short paragraph stating that Phase I of the operation had been successfully completed. One of the experimenters then briefed the subjects on the training vignette, explained their role in the organization, and posed the problem situation they were required to assess. At the start of the vignette briefing, subjects were given a Preparation Sheet which they could use to take notes on during the briefing or as they processed messages. The scenario briefing and overview of the simulator/modified email system took approximately 30 minutes. The presentation of the training vignette required approximately 10 minutes. Subjects were provided with a copy of the briefing materials as well as the full text of the background situation, the oplan, an associated intelligence annex, and the vignette description.

The practice and feedback portion of training ensued. For the practice and feedback portions of the training, and for the data collection scenario, each subject was paired with an experimenter-controller. During the practice and feedback portion of training, the controller helped the subject learn how to use the specialized email program. During both the training and the data collection scenario, the controller, playing the role of other members of the organization, responded to messages sent by

the subject. The controller also answered any questions the subjects had about the scenario, the task force organization used in the scenario, and their role. The practice scenario was run for 15 minutes, during which 38 messages were sent to the subjects. Subjects were asked to practice replying to, forwarding or generating new messages to ensure they knew how to do send out messages. Subjects in the training group were given feedback on their message processing actions.

The Post-training Questionnaire was administered after the practice and feedback components. Subjects were given as much time as they needed to complete it (approximately five minutes). One of the experimenters then gave a briefing on the data collection vignette, during which he pointed out important locations on a map overlay. As for the training vignette, the briefing included the problem situation, the subject's role in the organization, and his situation assessment task. The subjects were given a copy of the vignette description.

The data collection scenario ran for 30 minutes. Figure 3-7 depicts the data collection process. At the midpoint, the scenario generator was paused, and the subjects were asked to complete the Briefing Preparation form and then to do an oral sitrep in which they described the situation as they understood it at that point. Following the sitrep, the scenario was resumed for another 15 minutes. When it terminated subjects were told they could use a Briefing Preparation form to organize their thoughts. They then gave their final oral sitrep.

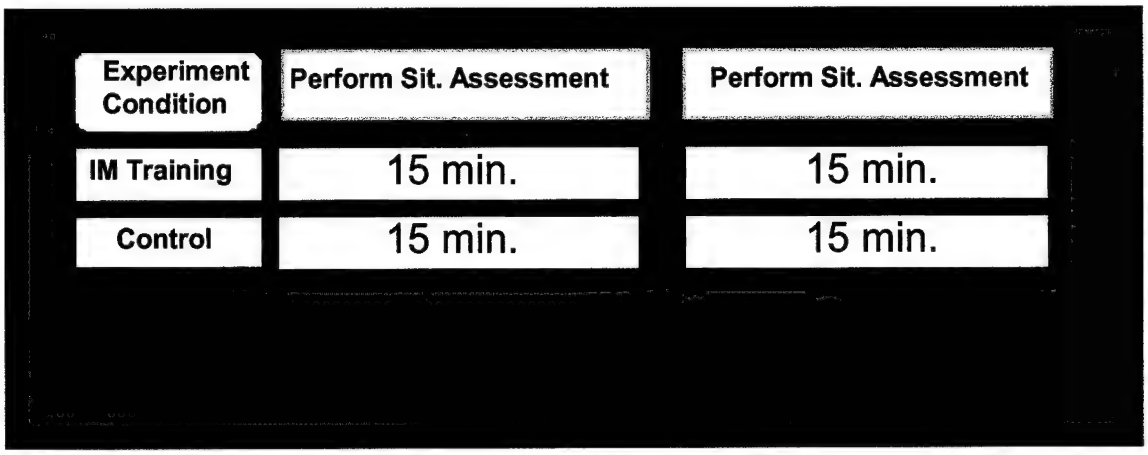

Figure 3-7. Data Collection Process for Evaluating Information and Management Training Program

After completing their final sitrep, subjects filled out the Post-Experiment Questionnaire and then were debriefed by one of the experimenters. Subjects were invited to provide any additional feedback they wanted on the training or the scenario materials. Finally, they were thanked for their participation and asked not to discuss the experiment until all the experiment sessions were completed.

3.2.5 Participants

The training evaluation was conducted in the Futures Laboratory of the Battle Command Battle Lab (BCBL) at Fort Leavenworth, KS. The 20 subjects who participated in the experiment were randomly assigned to experiment condition, with 11 receiving the IM training and nine receiving the control materials. The subjects, all of whom were affiliated with the BCBL at the time they participated in the evaluation, included 16 active duty officers and four retired military officers. All subjects had been in the military for more than 11 years, with the average for both the control and trained subjects being 18 years. Two subjects held the rank of captain, 10 were majors, seven were lieutenant colonels, and one was a full colonel. There was no significant difference between the control and trained subjects in terms of their rank or years of service.

3.3 TRAINING EVALUATION: RESULTS

In this section we focus on the results from the data collection scenario that we used to evaluate the effectiveness of the IM training program that we administered. We first present some information about the backgrounds of the officers who participated as subjects in the experiment. Then we present the analysis of the subjects' responses to the Post Training Questionnaire. We next examine the impact of the training program on the subjects' understanding of the situation, as conveyed in their interim and final sitreps. We then turn to the analysis of the message processing to examine the impact of the training procedure on the efficiency and effectiveness of the subjects' information processing actions.

3.3.1 Comprehension of Training Information

Following the practice and feedback portion of the training, we administered a Post-Training Questionnaire (see Appendix B) to assess whether the trained subjects comprehended the IM concepts and techniques that were discussed in the lecture and demonstration portions of the training program. To make the questionnaire seem appropriate for the control condition, we included, but did not score, questions about the Army of the future and the organizational structure described in the scenario that we used. In scoring the responses we gave credit for answers that reflected the procedures and techniques that were conveyed during training, including establishing key words that reflect critical information requirements, filtering according to information in the message header, and scanning messages for keywords.

We allocated a total of 12 points for the three questions that we scored (Questions 2, 3, and 4). Trained subjects achieved significantly higher scores (mean = 8.5) than control subjects (mean = 5.2) ($t = 3.64$, $df = 18$, $p = .001$[1]). Using the control mean as a baseline score, the results indicated

[1] Unless otherwise stated, the probability values a based on a one-tailed test of significance. We used a one-tailed test because we specified a priori the direction of the difference between means.

that after the training program was administered, trained subjects knew more about the IM concepts and techniques that were discussed than prior to training. The extent to which trained subjects could apply the concepts and techniques in a dynamic IM situation was assessed through their performance and information processing behavior in the evaluation scenario. We turn to those results next.

3.3.2 Performance

We hypothesized that the training procedure should enhance the ability of individuals to recognize and comprehend the critical information conveyed in the message traffic, and understand its implications for the problem that was posed. The training should also help subjects assess what information they are missing, and project where and how they can obtain that information. To evaluate this aspect of the training, we examined the subjects interim and final sitreps.

An SME blind to the experimental condition to which subjects were assigned scored the subjects' interim and final sitreps using the Situation Assessment Evaluation Scale that we developed (see Appendix B). The same form was used for both the written and oral briefings. The first part of the form listed the important themes conveyed in the critical messages. For the interim briefing we identified 10 important themes reflecting activities and events reported in the first half of the scenario. For the final briefing, we identified five themes reflecting actions that occurred in the second half of the scenario. The primary reason for having the SME score the presence/absence of these themes was to focus his attention on factors he should look for in the narratives and insure that he was extracting as much as possible out of the briefings.

The second part of the form includes three 7-point behaviorally-anchored scales reflecting three factors associated with information processing: the overall quality of the subjects' situation assessment; the degree to which subjects integrated information contained in the messages, and the extent to which subjects specified information seeking activities for improving SA and reducing

uncertainty. The same scales were used for the interim and final briefings. The SME rated the subjects' briefings on each of these scales, and these ratings served as the primary measures of performance.

Assessment of Interim Briefings

At the time of the interim briefing, the situation in the vignette was still ambiguous. The intent of the Country A's 9th Division was still unclear. The evaluations of the briefings reflected the extent to which subjects had picked up and assimilated the critical information supporting each of three alternative hypotheses advanced by intel officer about the intent of the Country A's forces.

Figures 3-8, 3-9, and 3-10 show that the trained subjects were consistently evaluated higher on the three overall assessment scales, both in their written and in their oral briefings. The differences on their overall quality of their situation assessment was significant for the written briefing ($t=1.81$, $df = 17$, $p = .044$) and marginally significant for the oral briefing ($t=1.33$, $df = 18$, $p = .099$). The difference between the two groups on integration of information in the messages was significant in the oral briefings ($t=1.72$, $df = 18$, $p = .051$), but not in the written briefs. The two groups did not differ significantly on the extent and appropriate with which they provided means to improve their situation assessment and reduce uncertainty. In part this may be because in the instructions to the subjects we did not explicitly ask for this information, and not all subjects offered it spontaneously. As Fig. 3.10 shows, the mean ratings on this scale were lower than on the other two scales for both groups.

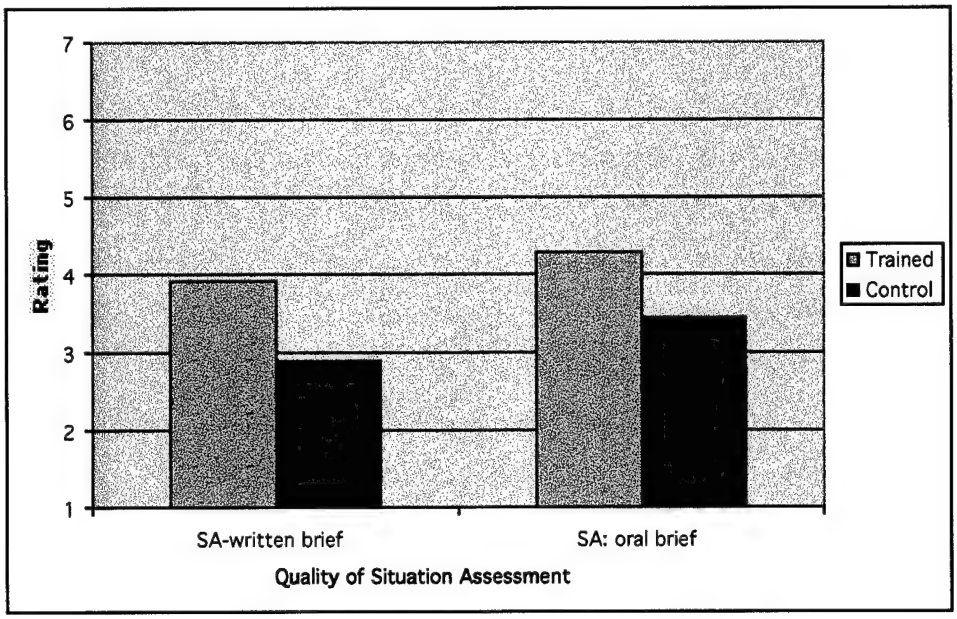

Figure 3-8. Quality of Situation Assessment in Written and Oral Briefs at Interim Briefing

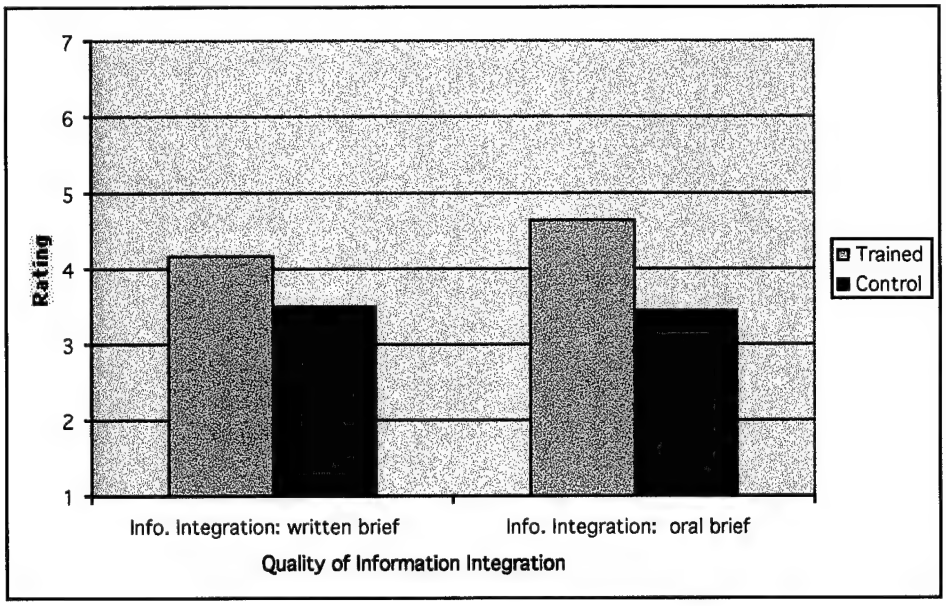

Figure 3-9 Quality of Information Integration in Written and Oral Briefs at Interim Briefing

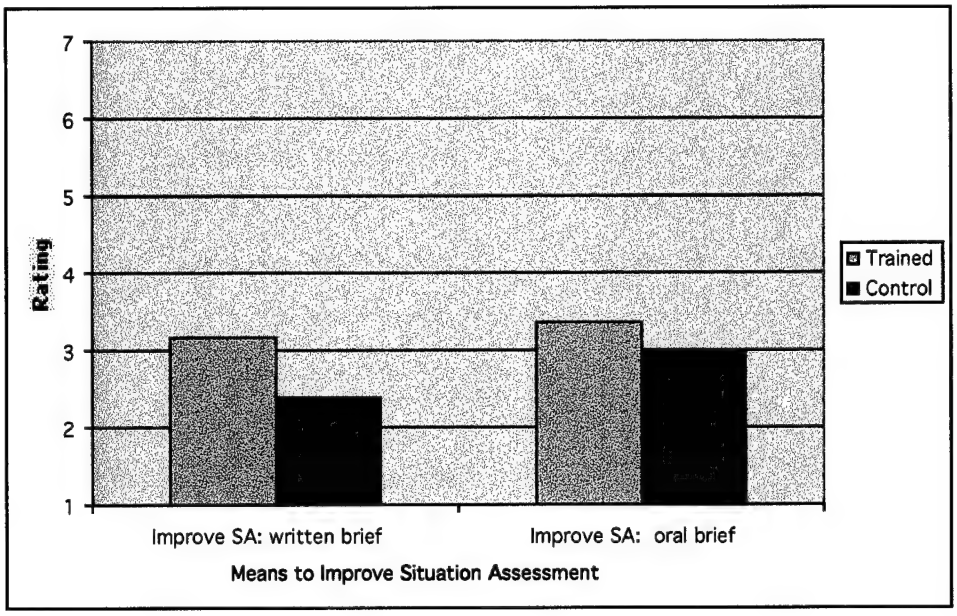

Figure 3-10 Extent and Appropriateness of Means to Improve Situation Assessment in Written and Oral Briefs at Interim Briefing

Subjects receiving training were better able than controls to integrate the critical information in the messages at the time of the interim briefing. The higher quality integration of information was reflected in the quality of their situation assessments, which were superior to those of the controls.

Assessment of Final Briefings

By the end of the vignette, it was evident from the messages that Country A's 9th Division was moving south toward the planned insertion area. Subjects' briefings were evaluated on the extent to which they provided supporting evidence for their conclusions, realized that the CTF plan had been compromised, recognized the need for replanning, and specified additional information requirements and potential sources for that information.

At the time of the final briefing virtually all the subjects had correctly assessed the situation. There was no difference in mean ratings for the trained and control subjects on the three

overall scales. We consider the possible reasons why the differences observed in the interim briefings were not evident at the final briefing in Section 3.4.

3.3.3 Message Processing: High-level Message Filtering

High-level message filtering pertains to the initial filtering individuals do in deciding which messages to attend to, and which messages to ignore, or at least put aside when processing time is limited. The first two components of the procedure offered in the training program (prepare and filter) combine to assist individuals in high-level filtering. In the preparation portion, individuals identify critical information they will need, and from where it is likely to come. For high-level filtering, individuals apply this to incoming messages. To assess subjects' high level filtering, we looked at the which messages subjects opened, the order in which they opened messages, and the their latency in opening messages – i.e., how long the messages sat in the queue before subjects opened them.

We looked first at the number of messages opened. Given that more than two messages per minute were delivered, we anticipated that subjects might not have enough time to open all the messages. The data confirmed that assumption. On average, subjects opened only 60 percent of the 80 messages that were delivered, and none of them opened all the messages. We did not hypothesize that the training would have an impact on the number of messages opened, and found none. The means for the two groups were virtually identical (48.6 for controls and 48.1 for trained).

Our hypotheses about differences between the control and trained groups concerned which messages subjects opened. One possible strategy, albeit not an effective one, is to go down the list of messages opening them in the sequence in which they appear in the message listing. Another strategy, the one advocated in the training program, is to choose which messages to open based on the source, subject, and timing information conveyed in the message header.

We hypothesized that trained subjects would be able to assess the information conveyed in the message header in light of the critical information requirements and information sources they had identified, and open more critical messages and fewer nonrelevant messages than control subjects.

Table 3-1 shows the percentage of critical, relevant, and nonrelevant messages opened by the trained and control subjects. Trained subjects opened a significantly higher percentage of critical messages ($t = 2.63$, $df = 18$, $p=.009$), a slightly higher percentage of the relevant messages and a smaller percentage of noncritical messages ($t=1.57$, $df = 18$, $p = .067$) than the control subjects. In other words, though both groups opened the same number of messages, trained subjects opened more of the critical and relevant messages than did the control subjects.

TABLE 3-1. PROPORTION OF CRITICAL, RELEVANT, AND NONRELEVANT MESSAGES OPENED BY TRAINED AND CONTROL SUBJECTS

Group	Critical (10 messages)	Relevant (32 messages))	Nonrelevant (38 messages)
Trained (n=11)	.93	.79	.36
Control (n=9)	.69	.73	.48

Figure 3-11 portrays this data in the form of a Receiver-Operator Characteristic (ROC) Curve (Green and Swets, 1974). The y-axis represents the proportion of critical messages opened- 'hits' in ROC terminology. The x-axis represents the number of noncritical messages opened – 'false alarms' in ROC terminology. The blue diagonal line represents cases in which the operator opens an equal proportion of critical and nonrelevant messages – i.e., chance performance. Performance of individuals who opened all the messages would fall in the upper right hand corner of the graph. The hit rate would be one, since they would have opened 100 percent of the critical messages, but the false alarm rate would be one as well, since they would also have opened all the noncritical messages. An individual who had perfect performance (opening 100 percent of critical messages and none of the nonrelevant messages) would be in the

upper left hand corner. Figure 3-11 shows that the trained subjects opened almost all the critical messages whereas the performance of the control subjects was close to chance.

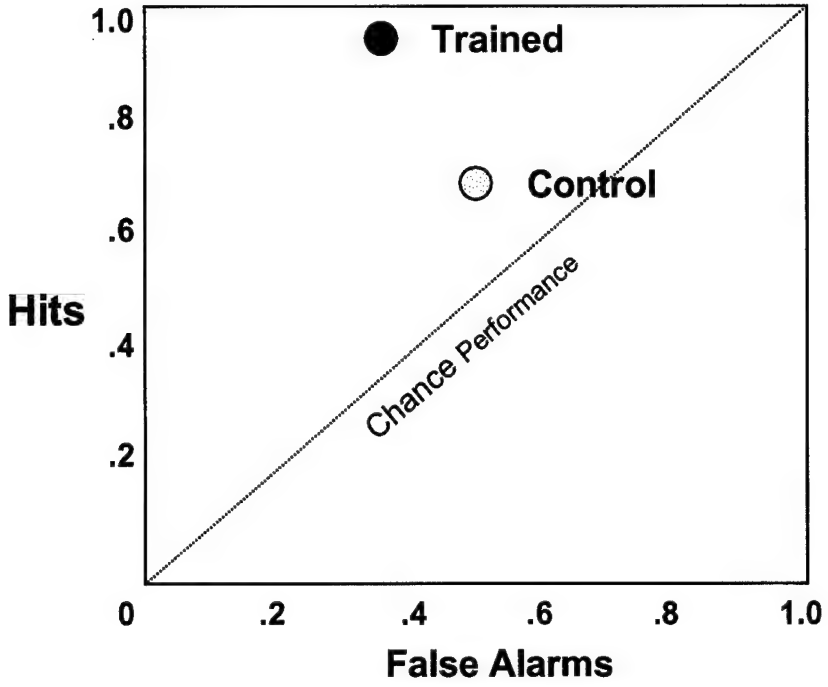

Figure 3-11. Proportion of Critical and Nonrelevant Messages (Hits and False Alarms, Respectively) Opened by Trained and Control Subjects.

Data from the post experiment questionnaire supports the conclusion that trained subjects were more selective about which messages they opened. We asked subjects to assess what proportion of the messages they left open for lack of time. The mean number reported by trained subjects was 15.8 percent while the mean for controls was 28.2 percent. Fifty-five percent of the trained subjects, but only 33 percent of the control subjects said they left less than 10 percent of the messages unopened because they did not have enough time.

We can also ask whether trained subjects were able to make decisions more quickly about which messages to open. To assess this, we examined subjects' latency in opening messages – i.e., the number of seconds that elapsed between the time messages were received and the time they were opened. If trained subjects are better prepared to filter out nonrelevant messages, we would expect

that they would decide more rapidly than do control subjects which messages to open. Therefore, the latency between time received and time opened would be smaller for trained subjects.

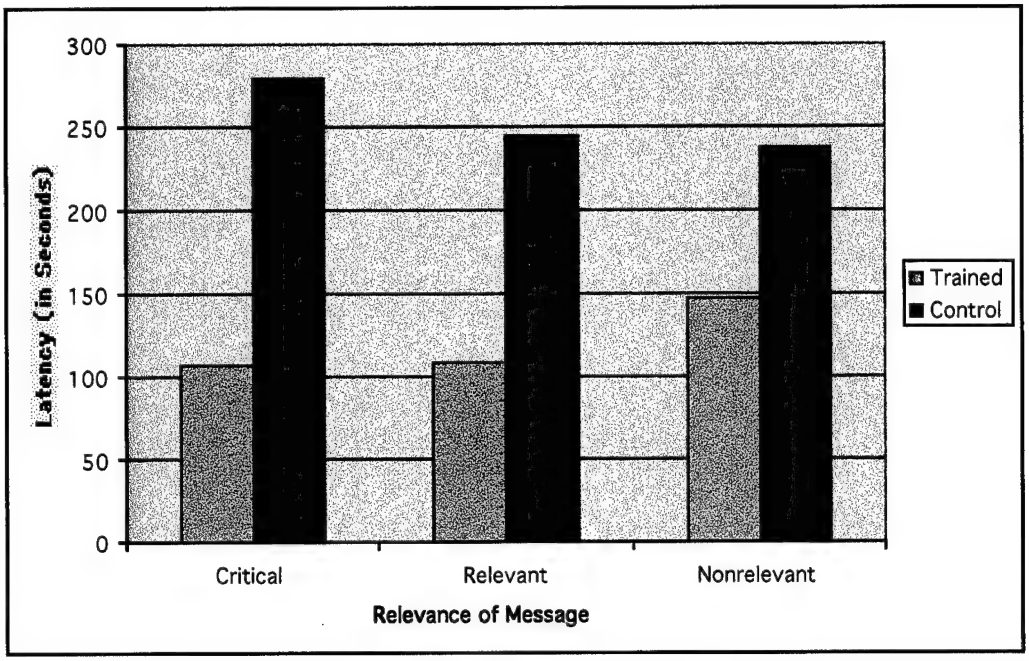

Figure 3-12 Latency between Receipt of Message and Opening of Message for Critical, Relevant, and Nonrelevant Messages

Figure 3-12 shows the mean latency in message handling for control and trained subjects, broken down by actual relevance of the messages. The figure clearly shows that the trained subjects opened all three categories of messages more rapidly than did control subjects. Across the three categories, the difference was marginally significant ($t=1.30$, $df = 18$, $p = .106$). Given that there was no difference in the total number of messages opened by each group, we cannot attribute the difference in message processing latency to the number of messages opened. The pattern portrayed in Figure 3-9 shows that the trained subjects opened critical and relevant messages more rapidly than nonrelevant ones, whereas the control subjects tended to open nonrelevant messages more quickly.

3.3.4 Message Processing: Content Filtering

A second level of assessment occurs when individuals open a message. At this point, they have decided that the message may contain pertinent information based on the information in the message header. In the training we emphasized the importance of identifying key words and phrases as a way of evaluating the importance of the message. When the message is opened, individuals must assess whether or not it contains information relevant for their mission. If they determine the information is not relevant, they should close the message as quickly as possible. If the message is deemed important, they should attend more carefully to the information that it contains. In the training program, this second-level evaluation was captured in the 'scan' step, the idea being that before carefully reading a message, individuals should scan it to see if it contains key words and phrases identified during the preparation phase. If subjects are effectively scanning messages to determine whether they contain important mission-related information, they should be likely close the nonrelevant messages more quickly than the critical ones.

Message Processing Time

We hypothesized that when messages were opened, trained subjects would read and close the nonrelevant messages more rapidly because they would have in mind a set of key words signaling that the message could be relevant for their mission, they would scan for those key words, and would rapidly close the message if those key words were not found. To test this hypothesis we calculated the trained and control subjects' message processing time – that is, the amount of time a message was open – for nonrelevant messages, but found no differences between the two groups. The mean length of time nonrelevant messages were opened was 23.7 seconds for trained subjects, slightly higher than the mean for control subjects, 20.7 seconds. Nor were there any differences between the two groups on the processing time for critical and relevant messages.

Not all individuals are able to scan text effectively, and it is possible that this is a skill that needs to be honed before it can be effectively applied as a deliberate message processing strategy. This conjecture gains some support from data in the post experiment questionnaire. Over 50 percent of the trained subjects but less than 20 percent of the control subjects mentioned using key words as a criterion for scanning. In other words, significantly more of the trained subjects than controls asserted that they were using key words to scan the text. But the message processing time data does not provide evidence that the trained subjects actually were scanning the text. It is also possible that the amount of time a message was left open may not be a sensitive indicator of whether or not individuals were scanning the text. Another kind of measure may be required.

Message Classification

We hypothesized that the trained subjects would be better able to evaluate the importance of the messages they read. To test this hypothesis we examined the subjects' ratings of the messages they opened. Table 3-2 presents the proportion of messages subjects opened that they correctly categorized as critical, important, and nonrelevant. The difference between the trained and control subjects' ability to correctly classify critical messages they opened was marginally significant ($t=1.36$, df 18, $p=.095$), but the differences for relevant and nonrelevant messages were nonsignificant.

An interesting feature evident in Table 3-2 is that within each relevance category subjects correctly classified only slightly more than half the messages. Close to half were misclassified. We examined the nature of the misclassifications to see whether they were confusions between adjacent categories (e.g., critical/relevant and relevant/noncritical), or were errors of extremes (e.g., critical called nonrelevant and nonrelevant called critical)?

TABLE 3-2. PROPORTION OF CORRECTLY CLASSIFIED CRITICAL, RELEVANT, AND NONRELEVANT MESSAGES OPENED BY TRAINED AND CONTROL SUBJECTS

Group	Critical	Relevant	Nonrelevant
Trained (n=11)	.65	.53	.59
Control (n=9)	.52	.55	.52

Figure 3-13 addresses this question. It portrays the trained and control subjects' ratings of the critical and noncritical messages they opened in the form of an ROC curve. The hits (y-axis) represent critical messages rated as critical and the false alarms (x-axis) represent one kind of extreme misclassification, noncritical messages rated as critical. Overall, the trained subjects were better able to identify critical messages and had fewer false alarms than the control subjects. The false alarm rate was quite low in both groups (.04 for trained and .11 for control subjects), suggesting that when a nonrelevant message was opened, it was unlikely that an individual mistook it as being critical. But this low false-alarm rate was reflected in hit rates that were only moderately high. The trained subjects identified about two-thirds and the control subjects one-half of the critical messages they opened, indicating that some critical information was not recognized by subjects in both groups.

To further understand the nature of the classification mistakes, we also calculated how often critical messages were called nonrelevant, and found an even lower error rate. On average, under three percent of the critical messages opened were called nonrelevant, and there was no difference between trained and control subjects in this regard. For messages they opened, then, subjects were unlikely to totally miss critical information. If they didn't rate it as critical, they at least identified it as relevant. The difficulty seems to be in distinguishing critical from relevant messages.

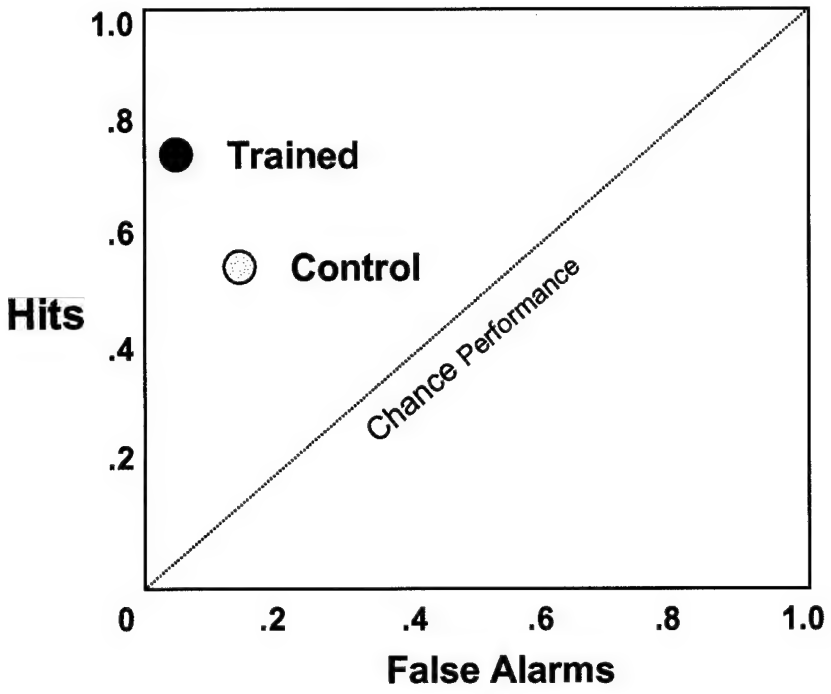

Figure 3-13. ROC Curve for Messages Opened

Finally, we looked at how subjects rated relevant messages. Table 3-2 shows that just over half the relevant messages were correctly classified. What about the remainder? Were they more likely to be mistaken as critical or as nonrelevant? We found that most relevant messages were called either relevant or critical. Few of the relevant messages (13 percent for trained and 15 percent for controls) were mistaken as nonrelevant. In other words, both the trained and control subjects were unlikely to dismiss relevant messages; their problem was in distinguishing the critical information, and the training did not have an effect in this regard.

3.3.5 Message Generation

One of the key concepts embodied in the training program was that individuals must be informed about the organization in which they are embedded. The training emphasized the need to consider where critical information would be likely to come from, and also the kinds of information that other nodes would need. The training program also stressed that a major source of information overload is unnecessary message traffic generated by individuals who forward

messages globally, or forward messages without modifying them so as to make the critical information salient for the intended recipient. This component of the training program should sensitize the trained subjects and help make them more effective information seekers and distributors. We assessed the effectiveness of this aspect of the training program by looking at the messages generated by the subjects.

Subjects were able to reply to messages, to forward messages with or without modifications, and to generate new messages. We looked at the number, types, and destinations of messages sent by subjects to other nodes in the organization.

Message Volume

We looked first at the overall number of messages that were sent. The training emphasized that individuals may unwittingly contribute to information overload by sending out unnecessary or irrelevant information, or by broadcasting information too widely. If the training was in making individuals careful about the messages they send out, we would expect that the volume of messages sent by trained subjects would be lower than the volume sent by control subjects.

The data showed that trained subjects sent out an average of 8.4 messages while control subjects sent out an average of 13.7 messages, more than half again as many. The difference between the two groups was marginally significant ($t = 1.30$, $df = 18$, $p = .106$). The results suggest that trained subjects were more careful about messages they generated. This attribution gains support from data in the post experiment questionnaire. More trained than control subjects indicated they did not send information to other nodes, and the trained subjects were more likely than controls to say that it was because it wasn't necessary to send any information to other nodes. Similarly trained subjects reported requesting information less frequently from other nodes than did control subjects. When asked why they didn't request information, trained subjects were more

likely to say it was because they didn't need any information, whereas controls were more likely to say it was because they didn't know where to get it or didn't know what to ask.

Messages generated by subjects include three types: replies to messages received; messages forwarded to other nodes; and new messages. Figure 3-14 shows that few new messages were generated by either control or trained subjects. For both groups, the majority of the messages generated were forwards. Control subjects replied to a slightly larger proportion of the messages whereas trained subjects forwarded more messages, but the difference was nonsignificant.

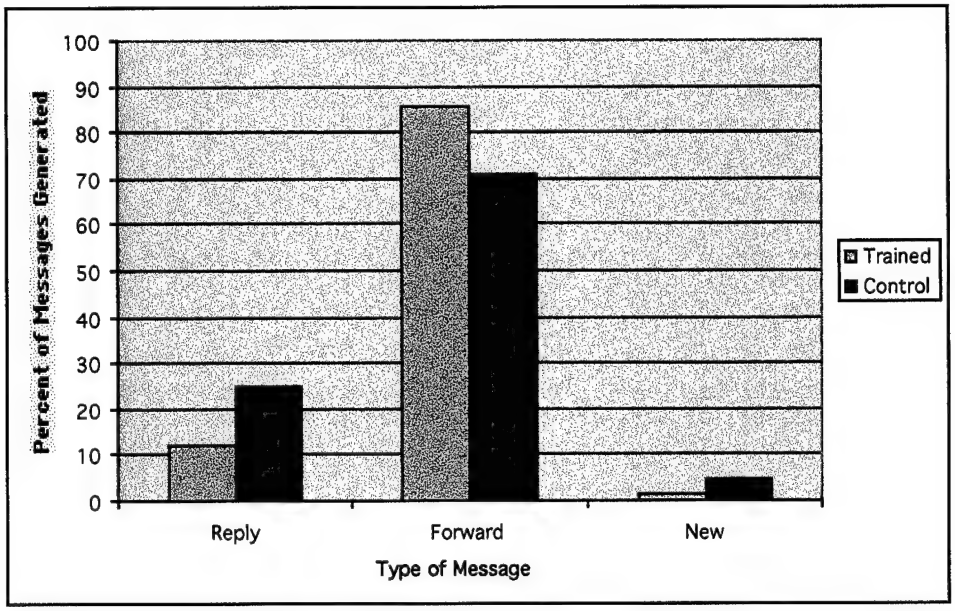

Figure 3-14. Distribution of Types of Messages Generated by Trained and Control Subjects

More significant than the number or type of messages generated by subjects is the nature of the messages that were sent out – do they contain relevant or nonrelevant information. Virtually all generated messages were replies or forwards, and both of these types are based on a source message that was received by the subject. Figure 3-15 shows the percentage of replies and forwarded messages that stemmed from critical, relevant, and nonrelevant source messages. The proportion of messages sent by trained subjects that pertained to critical source messages was significantly higher than the proportion sent by controls ($t=2.24$, $df = 18$, $p = .019$), and conversely, the

proportion of messages that pertained to relevant source messages was significantly higher for control subjects ($t = 1.94$, $df = 18$, $p = .034$). Both groups of subjects generated few messages that were based on nonrelevant source messages. These results indicate that trained subjects were more attuned to critical information in the message traffic they generated.

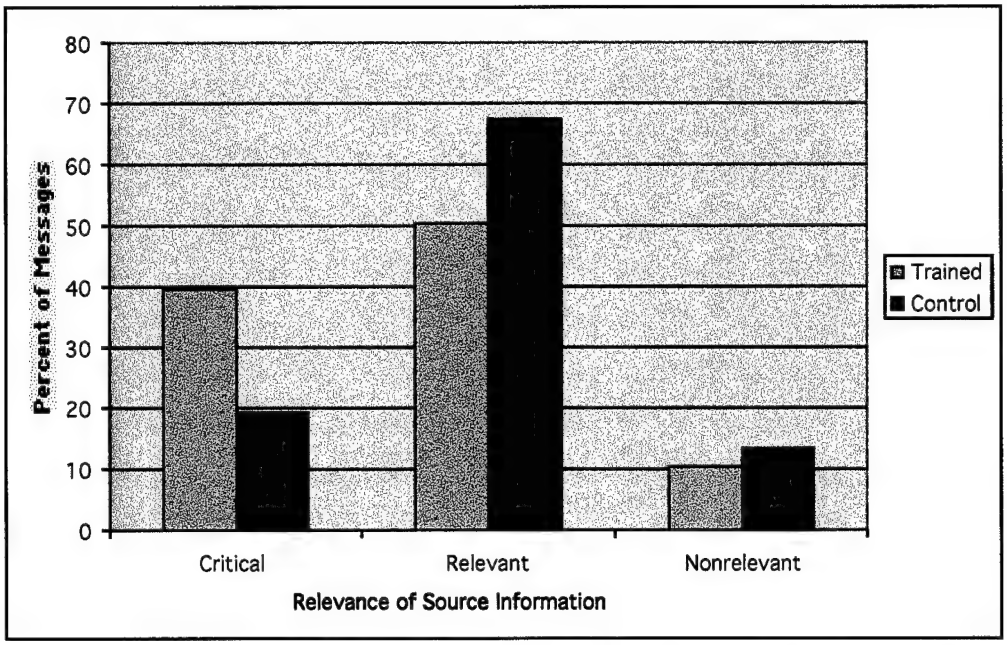

Figure 3-15 Percentage of Messages Generated based on Critical, Relevant, and Nonrelevant Source Messages

Depth of Message Processing

To shed further light on how training impacted the nature of messages that were transmitted, we examined the amount of processing that was done on the messages that were sent out. To measure depth of message processing, we created three categories of messages: 1) messages that were simply forwarded to another node without any modification; 2) messages that were modified in some way, and; 3) newly created messages. We hypothesized that the trained subjects would be more likely than control subjects to modify forwarded messages or generate new ones, but the data did not support this hypothesis. As shown in Figure 3-14, few new messages were generated by either group. Of the forwarded messages trained and control

subjects were equally likely to forward the message without any modifications or additions. This result may in part reflect the trained subjects' belief that the entire message was relevant, and there was no need to summarize or restate it, but it also suggests that the aspects of the training program that help individuals minimize unnecessary information in messages could be bolstered.

Message Destination

When subjects forwarded messages, they could send them to single node or to multiple node destinations. For example, a message sent to the aviation brigade goes to that single node. A message sent to Force IV goes to all the nodes in Force IV. A message to multiple nodes is more likely to be a source of information overload because not all the nodes receiving the message may require the information it contains. The data showed that control subjects were more likely to send one or more of their messages to multiple nodes than were the trained subjects, with 56 percent the control and 44 percent of the trained doing so. The difference is not significant, but does point to slightly more caution and care on part of trained subjects in terms of how widely they broadcast their messages.

We examined the level in the organization to which messages were sent. Trained subjects sent more messages to higher authority than laterally or to subordinates. That finding is consistent with the expectation of the SME who designed the scenario who similarly suggested more messages that were appropriate for direction to higher authority than messages that should be directed to lateral or subordinate units.

3.4 TRAINING EVALUATION: CONCLUSIONS AND DISCUSSION

3.4.1 Conclusions

The training program was designed to help individuals be efficient and effective information managers. The evaluation experiment was designed to assess the effectiveness of the training program by analyzing participants' processing of information and their situation assessments. We examined participants' attention to incoming messages, their evaluations the criticality of the

messages and their processing of outgoing messages. We assessed the degree to which they comprehended and integrated the messages they read from their written and oral sitreps.

The performance results showed that the trained subjects' ability to integrate and assess critical mission information was superior to that of the controls. The effectiveness of the training was evidenced in the interim evaluation, the time at which the situation was most fluid and uncertain, and was reflected in the higher quality of the trained subjects' situation assessment and their integration of information in the messages.

The information processing data provided behavioral evidence for the effectiveness of the training program, and indicated why the performance of the trained subjects was superior to that of the controls. On average, trained and control subjects opened the same number of messages, but the trained subjects opened messages more quickly than control subjects. In the experiment, we observed that whereas a control subject might move the cursor up and down the list of messages while deciding which message to open next, trained subjects were more definitive in the selection process, rapidly bypassing those messages that were nonrelevant and opening those that might be relevant. These data and observations suggest that the preparation component of the training was successful in helping subjects clarify what critical information they needed, and from were the information might come, and therefore they spent less time deciding which messages to open. Consistent with this inference, we found that the trained subjects opened a higher proportion of the critical messages and a smaller proportion of the nonrelevant messages than the controls. Trained subjects were also more likely to correctly classify critical messages they opened than control subjects.

Trained subjects were more careful information generators. They generated fewer messages than controls, were more likely to distribute them to single rather than multiple nodes, and more often directed them to the appropriate level in the hierarchy. In other words, they saw

more of the critical information and had more time to read and integrate the messages, in part because they opened messages more rapidly than controls and in part because they spent less time generating message traffic.

3.4.2 Discussion

Significant components of both the performance and the information processing results showed that the training program was effective in improving the trained subjects' IM skills. There were, however, certain aspects of the results that did not confirm differences between the trained and control groups.

As noted previously, virtually all the subjects solved the problem that was posed in the vignette – i.e., the intentions of the Country A's 9th Division. Given the significant differences between the trained and control groups' performance in the interim briefings, we attribute the inability to detect a difference in the final sitreps to a ceiling effect caused by a too simple resolution of the problem in the second part of the evaluation vignette. A more sensitive evaluation would have been obtained had more uncertainty remained in the situation. With little or no ambiguity present by the end of the vignette the performance of all the subjects became quite similar – any differences were too subtle to detect in the assessment scales we used.

One of the behavioral components in the training program advocated scanning messages that are opened for key words and phrases identified in the preparation phase. Both the post-training and post-experiment questionnaire data showed that the subjects understood the concepts of identifying key words and scanning for those key words in the messages. The latency data, however, did not provide evidence that trained subjects were more likely than controls to use the scanning technique. The lack of evidence for scanning may have two explanations. It may be that the measure we used, the length of time messages were left open, was not appropriate for differentiating between scanning and reading. Alternatively, it may be the case that although

trained subjects were aware that they should scan the messages, scanning is a skill that many of them do not have.

Some facets of the message generation data showed that the training was effective in limiting the transmission of nonrelevant information. For example, messages forwarded by trained subjects were more likely to pertain to a critical source message than were the messages generated by control subjects. However, trained subjects were as likely as controls to forward messages without modification. Clearly it is easier and quicker to forward a message wholesale than to revise it. The results indicate the need to bolster aspects of the training to encourage tailoring the message content for the intended recipient.

We feel the most appropriate target audience for the IM training would be military officers who have newly been exposed to the MDMP – before they have had a chance to establish their own IM style and process. It is a much more lengthy and difficult process to break down old behaviors before building up new behaviors, and the training program we developed did not incorporate procedures to do such a thing. The individuals who participated in this study are (or had been) mid-career officers, all of whom already had intensive training on information management, and many of whom had extensive experience as information managers in situations similar to the one portrayed in the training evaluation vignette. Both of these long term factors probably had a mitigating effect on the impact of a two-hour training program. That differences between the two groups did emerge attests to the effectiveness and promise of the training program we administered.

The comments of one of the participants who said he has worked in systems with large numbers of messages in the queue supports our belief that the training we provided is on the mark for military officers. He remarked that the training method suggested is just like what he does, But he has never before categorized it in that way. He felt the training was helpful in that it provided an

organizational framework for what he has been doing. We believe that providing this framework is itself a means of encouraging and reinforcing effective information management.

CHAPTER 4

CONCLUSIONS AND IMPLICATIONS FOR INFORMATION MANAGEMENT TRAINING

Four interrelated activities were conducted in this project: 1) iterative development of a model of information processing; 2) conduct of an experiment to assess the impact of differing levels of information load and different levels of organizational knowledge; 3) development and evaluation of the preliminary version of an information management (IM) training program, and; 4) development and evaluation of a test version of the IM training program. In the first section of this chapter we show the ways in which the IM training prevented information processing errors that have been observed. In the second section we present a modified version of the IM model that incorporates the findings from the two training evaluations we conducted. In the third section we address suggested enhancements and extensions to the IM training program and to the materials used to evaluate its effectiveness.

4.1 PROJECT SUMMARY

As a result of the work discussed in the previous chapters, we have gained valuable insights into the original model of information management. Figure 4-1 provides an annotated version of the IM model that we used as a basis for the IM training program to show which areas of the model were most influenced by the training program. The model was developed on the basis of theories of cognitive processing and observations of information processing in naturalistic and experiment settings. The annotations in the figure show information processing errors identified in observations made in naturalistic settings and in the experiment we conducted to assess the impact of information load (referred to as Experiment 1 in the figure). The green blocks

in the figure show that the training program we developed addressed all of the areas where typical errors occur. The numbers in the blocks correspond to the numbers in the explanatory text below.

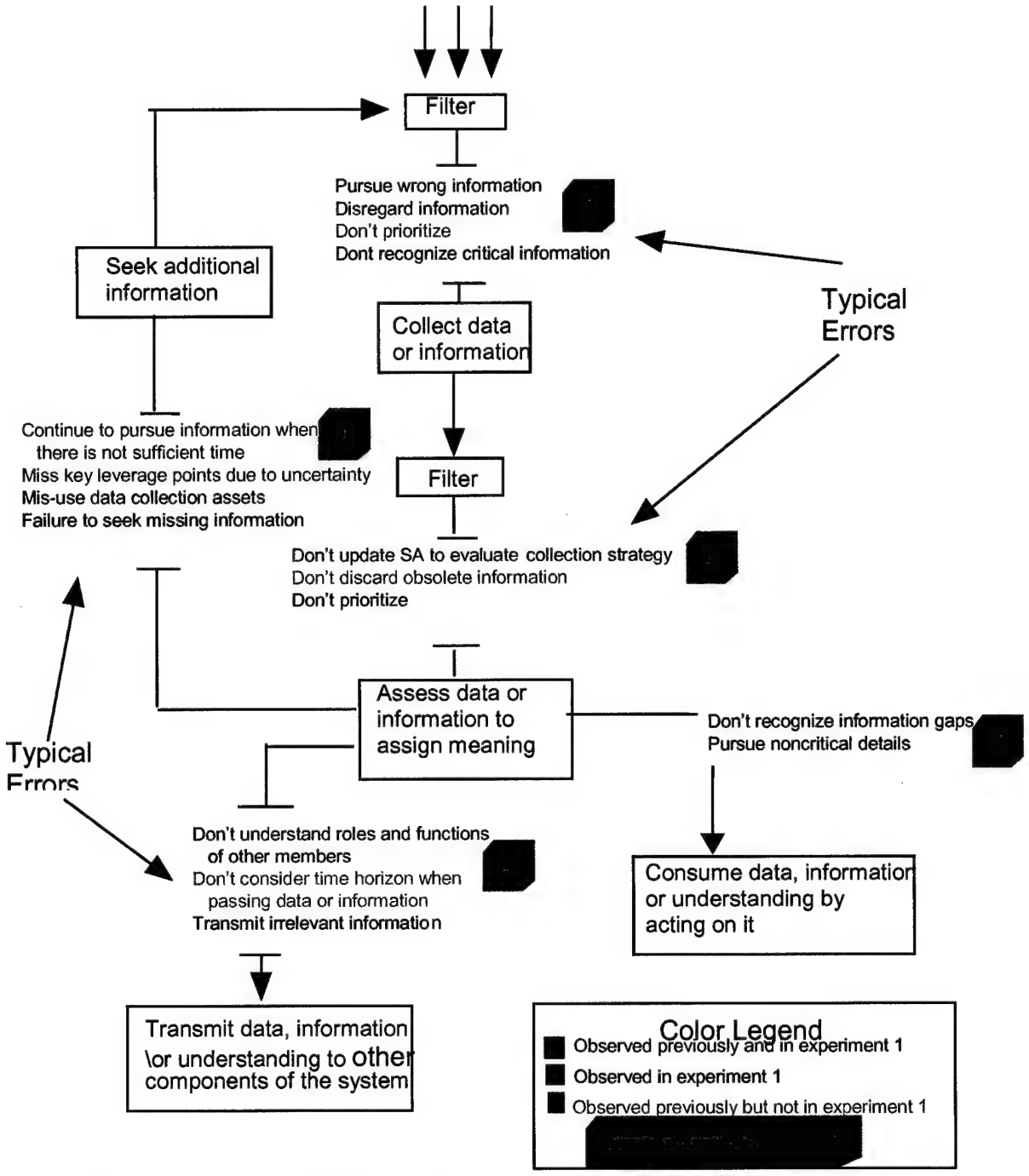

Figure 4-1. Areas of Training Influence on Information Processing Errors

The first area of influence (see number 1 in Figure 4.1) is at what is considered the high level filter – that part of managing information where the manager categorizes the incoming information as "potentially important and deserving of a more in-depth look" or "not relevant" based on the high level information attributes that are apparent when information first arrives (e.g., with email, such information would be the source, subject, and date). Typical errors that occur at this stage of managing information are pursuing the wrong information, disregarding information, and not recognizing critical information. As a result of the training program the participants opened fewer nonrelevant messages, more critical messages, and opened the critical and relevant messages more quickly than control participants did.

The second area of influence (see number 2), the second level filter in the IM model, was also positively affected by the training program. Specifically, the trained participants more accurately rated critical messages after they were opened than the control participants did. We were not able to ascertain directly whether the trained participants used an updated assessment of the situation to evaluate and revise their collection strategy (i.e., to revise the high-level filter); however the finding that the trained participants had a better interim assessment of the situation suggests that they were more prepared to do so if they felt it was necessary.

Our study also revealed evidence that the training program positively affected the third area of influence noted by the number 3 in Figure 4-1. During the study control participants reported that they did not seek information because they didn't have time, whereas the trained participants sought little information because they felt that they did not need any information. These findings suggest that the control participants experienced the failure to seek additional information, whereas the trained group realized that they could seek information if necessary, but they simply did not find it necessary. It is possible that because the trained subjects opened messages more quickly and opened a higher proportion of critical messages, they felt more

confident that they were receiving all of the information they needed, and concluded that it was not necessary or prudent to query other nodes for any additional information that might be available.

The fourth area of influence (number 4) concerns refraining from contributing to other people's information overload. As a result of the training, trained participants sent fewer messages, a greater proportion of which were critical, to other nodes in the organization. They sent messages to fewer nodes at once, and were more likely to send the information to the appropriate level in the organizational hierarchy. These findings suggest that the training resulted in behaviors that would lessen the possibility that other information processors would experience information overload.

The final area of influence (see number 5) was evident at the interim brief. The trained participants were better able to assess the situation (e.g., what they knew about the situation and what gaps still existed) halfway through the scenario than the control group.

As these findings suggest, the training program was quite effective in counteracting many of the typical errors that occur in information management. Some errors noted in Figure 4-1, such as continuing to pursue information when there is not sufficient time, were not pertinent in the vignette that we used to assess the training effectiveness, and therefore the effectiveness of the training program in preventing them could not be assessed. We discuss this further in Section 4.3, in the context of potential refinements and additions to the scenario.

4.2 ENHANCEMENTS TO INFORMATION MANAGEMENT MODEL

Figure 4-2 illustrates the IM model that has been a guiding factor throughout this project. To the left is the original model with areas of most development highlighted with the red boxes. To the right is the model as it has evolved over the course of the project. As this figure illustrates,

the major changes in the model have less to do with additions or deletions of steps in the IM process and more to do with the expansion of the steps as originally presented. The major changes are described in turn below.

One new addition to the model is the initial preparation step shown in the top of the revised IM model. In the initial model, this step was implicit – it was simply assumed that effective information managers would take the time to prepare before becoming engulfed in their IM task. Throughout the project, however, it became clear that preparation is a key step in managing information that is overlooked – or actively shunned – by poor information managers. Because it is so essential to the successful management of information, we have added it as the initial step of the IM process.

This initial preparation is not intended to be a burden to the information manager; on the contrary, it is thought of as a cursory "thought organization" that will result in a more efficient IM process. Preparation entails actively thinking of the commander's intent, considering what information is needed (e.g., key words and phrases), where that information might come from, where information received might go (both of which require knowledge of the organization), and how to determine the importance of information received from the commander's intent. This quick preparation primes the information manager so that important information is more quickly recognized and nonrelevant information can be quickly discarded. Many experts practice this preparation step without thought; however, nonexpert information managers do not instinctively see the benefit to taking the few minutes necessary to prepare for information management and they must be trained to do so.

After the initial preparation, the information manager must apply a high level filter to the information being received. One of the assumptions of this IM model is that information managers receive considerably more information than they can comfortable consume in the time

allotted, so this first information filter involves categorizing the information (e.g., "could be important and deserves a more in-depth look" vs. "not relevant") based on the high level information attributes that are apparent when information first arrives (e.g., with email, such information would be the source, subject, and date). The actual filter is derived from the key information requirements determined in the preparation stage, and only those messages that pass this first filter should be looked at in more detail.

Those messages deemed "potentially important" should then be opened and the information manager should quickly scan for the relevant key words and phrases (as determined in the preparation step). Only those messages containing the important key words and phrases should be read in more detail, and only those messages that are read are used in further actions.

Another addition to the IM model is the feedback loop connecting "scan and read" to the initial filter. Information management is a dynamic process, an aspect that the initial model did not capture, so this feedback loop was added to represent the adaptable quality of managing information through which incoming information may result in a revision of the initial filter. It is only with a process such as this that efficient information management can take place.

A final addition to the model is the impact organizational knowledge has on the information management process. Knowledge of the people within the organization, and their communication needs and styles, is necessary for establishing an effective initial filter (who might send the needed information), determining what to do with the information once it is received, and knowing where to seek for information that is still needed. Without a solid understanding of the organization, effective information management is improbable. The more likely result is that the information manager contributes to information overload.

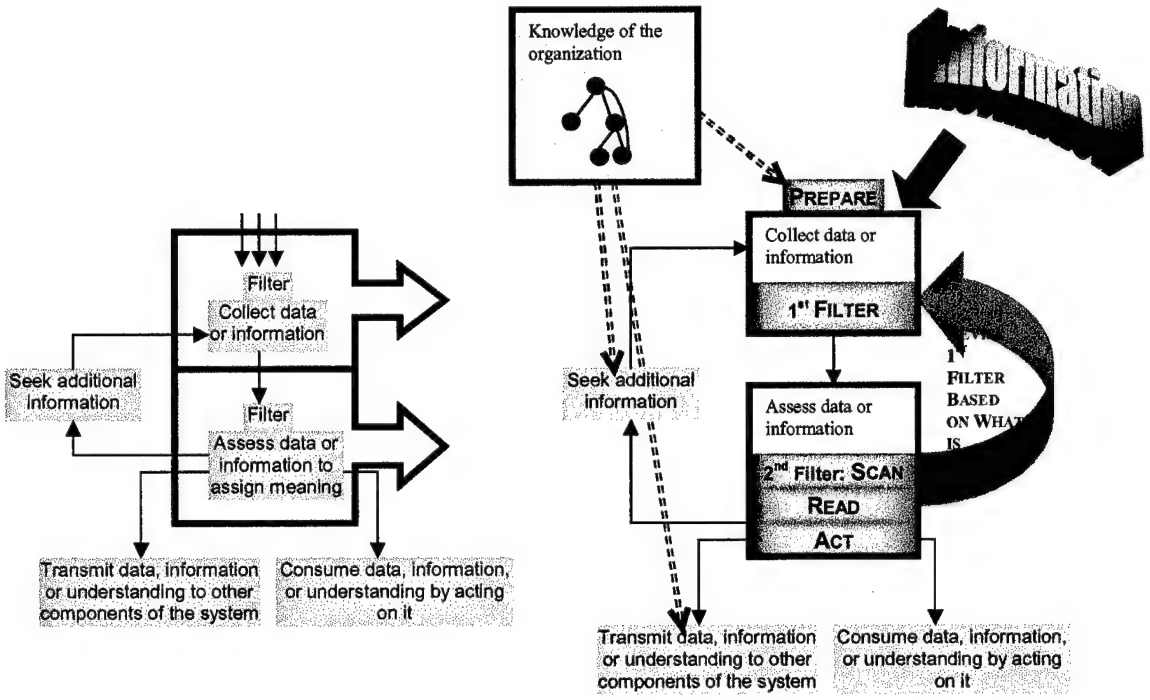

Figure 4-2. The Updating of the Information Management Model

4.3 FUTURE REFINEMENTS AND DIRECTIONS

4.3.1 IM Training Program

The test version of the IM training program was successful in many regards. But each administration of an evolving training program reveals refinements and new options to make the program even stronger and more robust. Observations of the training program as it was conducted, observations during the evaluation phase, and comments made by the participants are additional sources of data that supplement the findings based on the analysis of the performance and processing data. All of these sources together suggested additional modifications and enhancements to further strengthen the IM training program. We consider some of these here.

Several of the more experienced participants noted that they are already trained to receive the Commander's Critical Information Requirements (CCIRs). To insure that the training does not appear redundant with what has already been taught, the trainer could stress more heavily in the

lecture portion that although officers are already trained to receive CCIRs, the thrust of this training program is to provide heuristics that are robust to factors that degrade cognitive functioning, such as fatigue, time pressure, or adverse environmental conditions.

The test version of the training program promoted the idea of scanning a message to assess its relevance. In constructing the training materials, we assumed that participants were efficient scanners, but we now believe this assumption was probably mistaken. The measure we used (amount of time messages were left open) did not provide any evidence for scanning. We suggest that in the future, IM training should incorporate a classroom-type segment in which all trainees are taught how to scan more effectively and efficiently.

In addition to any training that is provided in how to scan text, to more effectively convey applications of message scanning, the demonstration portion of the training program should include a greater number of examples in which a message is opened, scanned for key words and phrases, and deemed not relevant, as well as examples in which key words are detected and the message is read more carefully.

As we show in the updated IM model in Figure 4-2, information management is a dynamic process. The training could be enhanced by an increased emphasis on dynamically changing information needs. Examples in the demonstration and practice portions of training that lead to adding new key words, or, conversely, deleting a key word, would emphasize the dynamic nature of information management. Similarly examples in which the most likely source of critical information changes over time would reinforce awareness of the dynamic nature of information management and the need for organizational knowledge.

The finding in the evaluation of the test version of the IM training program that most of the messages that were transmitted were forwards of an existing message, rather than newly composed messages or modified forwards, suggests that the effectiveness of the training program could be

enhanced by material that reinforces efficient information push. We did address this in the training program, but in subsequent training we would emphasize this facet of information management with additional examples of succinct and focused messages in the demonstration portion.

We observed during the training evaluation that participants did not always pay attention to who were the other recipients of messages they received. We noted several instances in which subjects forwarded a message to a node that had already received it, as, for example, forwarding to a specific node in a unit a message that was originally addressed to all nodes in the unit. The training should stress the importance of noting who has already received the message, particularly in cases where the message is sent to a group composed of multiple nodes. Attention to the list of recipients needs to be emphasized in the lecture and exemplified in the demonstration portion as something to pay attention to.

In the administration of the training program, we placed a lot of emphasis on identifying key words, and we exemplified this in the demonstration phase. In part because the amount of time available for training was limited, we could not follow through to a sufficient degree during practice and feedback. If possible, in future administrations it would be preferable to allot more time to the practice and feedback portion of the training so that the trainer could spend more time talking with the participants about whether they were appropriately filtering the messages, both in terms of high level and secondary filtering. The trainer needs to actively query the participants about the keywords they are using to be sure participants have enumerated them, and to provide feedback to the participants on whether they are applying the key words appropriately.

The testing methodology used in the program was not designed to assess the durability or robustness of the training program over time. For this project we trained participants and then assessed the effectiveness of the training immediately thereafter. Although we have strong

evidence that the training positively affected IM activities that occurred immediately following the training, we do not know whether the positive impacts of the training will endure over time. Ideally the training would permanently change people's behavior, and the behaviors we trained would persist over time. Future experiments in which the effects of IM training are assessed over time would address this issue.

4.3.2 Evaluation Materials

A sensitive and thorough evaluation of a training program is needed to assess the degree to which it is effective, and also to pinpoint weaknesses in the program, identify aspects that could be strengthened, and suggest possible additions. The quality of the evaluation depends upon the scenario materials that are used, the evaluation instruments that are developed, and on the capabilities of the simulator that is used to generate the scenario and to capture subjects' actions and responses during the evaluation. Based on the observations and analyses made during this project, we have identified improvements that could be made to the scenario materials and the simulator, as well as possible changes to the evaluation procedure.

Enhancements to Scenario Materials

When the amount of time available for training is limited, it is often challenging to fit in all the components of the training and training evaluation. One of the factors that often falls short is the amount of time available to become acquainted with the names of places, roads, and geographic features of the locale in which the scenario is set. For example, many participants were not familiar with the geographic area for the scenario used in this project, and felt they needed more preparation time to become familiar with the locations of key areas of interest. A suggestion made by one of the participants is that the scenario could be set in a location that is familiar to most Army officers – for example, the National Training Center in California. Using familiar terrain would reduce the amount of time needed to become familiar with the map features.

As we noted in Section 4.1, several of the IM errors described in Figure 4-1 could not be detected with the existing scenario. For future evaluations, specific 'information gaps' could be deliberately planted in the scenario to assess whether the training helped participants to recognize these gaps. The scenario could be designed to include a sequence of related but nonrelevant messages. This could be used to assess whether trained participants are less likely to pursue nonrelevant information, for example by tracking down activities occurring at locations that are not relevant to their mission. A scenario could also be constructed to emphasize critical time windows. It is difficult to incorporate a test for every possible kind of error in a single scenario. When time permits, an evaluation involving several different scenarios would be advantageous.

Enhancements to the Simulator

We identified several modifications that would improve the flexibility and capability of the simulator. These suggestions are based on observations made by the experimenters and comments made by the participants.

- Provide the capability to delete messages from the queue. This is a standard email program capability that was not implemented in the scenario generator we used. Providing it would allow for a clearer differentiation between messages subjects decided were nonrelevant and messages they didn't have sufficient time to open.
- Provide the capability for multiple recipients of messages. Unlike typical email programs, the scenario generator did not permit users to have multiple recipient of a message. This is a realistic requirement that could be added, and is important for assessing the aspects of IM training concerned with knowledge of the organization.
- Provide the capability to file messages into specific folders. This is a capability available in most email programs, and one that several participants requested. Adding it to the scenario

generator would allow the experimenters to obtain data on how information managers group messages they receive, and how they applied knowledge of the organization.

- Provide an easy mechanism to send messages to recipients that are not on a prespecified list. At present messages can only be sent to nodes on a predefined list. Adding this feature would allow for better assessment of aspects of training concerned with information transmission.

Changes to the Evaluation Procedure

A number of participants commented that the scenario procedure was rather unrealistic. Although subjects could send messages requesting information or directing actions to be performed, they did not receive much feedback on these requests, in large measure because of the need to maintain experimental control across subjects. The officers who participated in the training suggested that in future administrations the participants should have a more active role and be more than passive information managers. It would also be more realistic and more interesting to have some messages delivered via different media. This requires a scenario that is more interactive, involving a situation with multiple participants. To maintain experimental control, it may be possible to have some of the roles played by confederates rather than other participants.

4.4 CONCLUSION

The goals of the current program were to develop a theory-based model of information management, and from that to develop a training program that can be used to train effective information management. As is documented in this report, this program did just that; a training program focused on the specific behaviors "prepare, filter, scan, read, and act" did help information managers deal more effectively with large amounts of information. In the preceding section we discussed ways in which we can improve upon our training paradigm and develop

it even further. The program we have developed fits in a niche that has been overlooked by researchers. There are training programs intended to help decision makers make better decisions (e.g., SHAPE; Härtel & Härtel, 1997); however, none of these other training programs focus exclusively on the process necessary to manage and integrate large amounts of information – a process Shattuck and his colleagues call "cognitive integration" (Shattuck, Graham, Merlo, and Hah, 2000) – and the specific behaviors needed to do that. Until automatic filtering systems improve dramatically enough to make the need for human filtering obsolete, a training program that focuses on specific behaviors such as Prep, Filter, Scan, Read, and Act can help people manage large amounts of information more effectively. Not only can people learn to better recognize and focus on important information, but they can learn to change behavior in such a way that they no longer contributes to other people's overload.

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APPENDIX A

Information Management in Distributed Organizations

Introduction to the Study

Under the sponsorship of the Army Research Institute, ALPHATECH, Inc. and APTIMA, Inc. are conducting a research project exploring information management in distributed organizations. The Systems Engineering Department at the Military Academy is supporting us in this project and has given us permission to send you this packet of materials and ask for your participation.

You will participate in this study in three class periods during the week beginning November 1. At the beginning of the first class period on Monday, we will ask you to sign a Consent Form indicating that you are willing to participate in this study and we will administer a brief quiz to determine your retention of the materials in this package (explained below). After this initial paperwork, the first two class periods (Monday and Tuesday) will focus on training to prepare you for the scenario – which includes training on the simulator that you will use for the experiment.

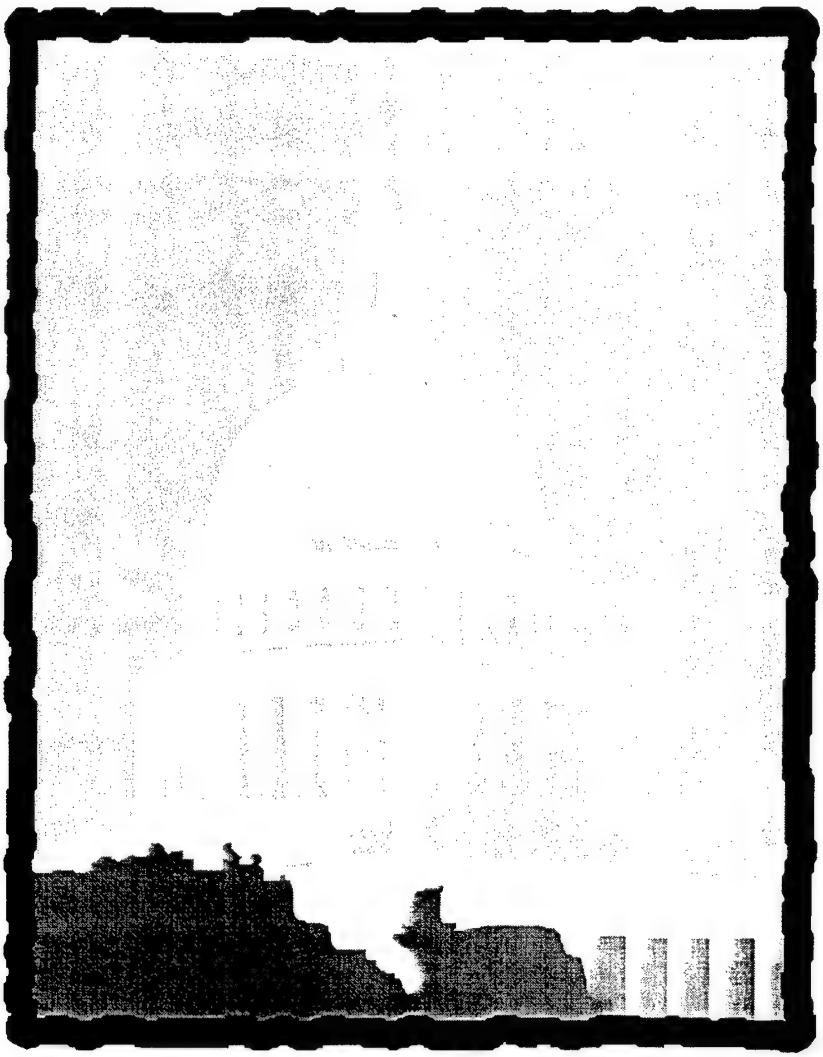
During the third class period (Wednesday, Thursday, or Friday) you will participate in an experiment designed to help us explore information management in distributed organizations. During this experiment you will play the role of a Joint Force Commander who must develop an assessment of the situation based on a written situation brief and a series of written or verbal update messages received through e-mail. During the experiment you will be asked to give two situation briefings (SITREPs), one at the midpoint of the experiment and one at the end. At the midpoint you will deliver your situation briefing orally, and at the end you will deliver both a written and an oral briefing. At the end of the experiment on the third day, we will give you a post experiment questionnaire that we ask you to complete and return to Maj. Kewley in class Tuesday, 9 November.

We are asking you to spend approximately one to one and a half hours reading through two booklets that are included in this package before you come to the class on Monday. The first one describes the background situation for the scenario that will be used in the experiment. It is entitled "The Road to War". The second one, titled "Gaining Organizational Knowledge", describes the military organization that is used in this scenario. To prepare for the first class period, we ask that you look over the scenario and carefully study the material explaining the organizational structure. It is important that you understand the organization in which you will operate. Don't be intimidated by the bulk of the two handouts. They contain a number of maps, tables, and charts that take up a good amount of space on the page without adding much "read time." Please bring these materials with you to both training sessions and the experiment.

The data that we are gathering will be used for research purposes only. Your participation in this study will help us determine how people are affected by high levels of information, and what can be done to improve performance in times of high information load. Because we want to obtain unbiased responses from each participant in the study, we ask that you not discuss this study with other cadets until everyone has turned their materials in to Maj. Kewley on Nov. 9.

We thank you in advance for supporting this study.

Gaining Organizational Knowledge

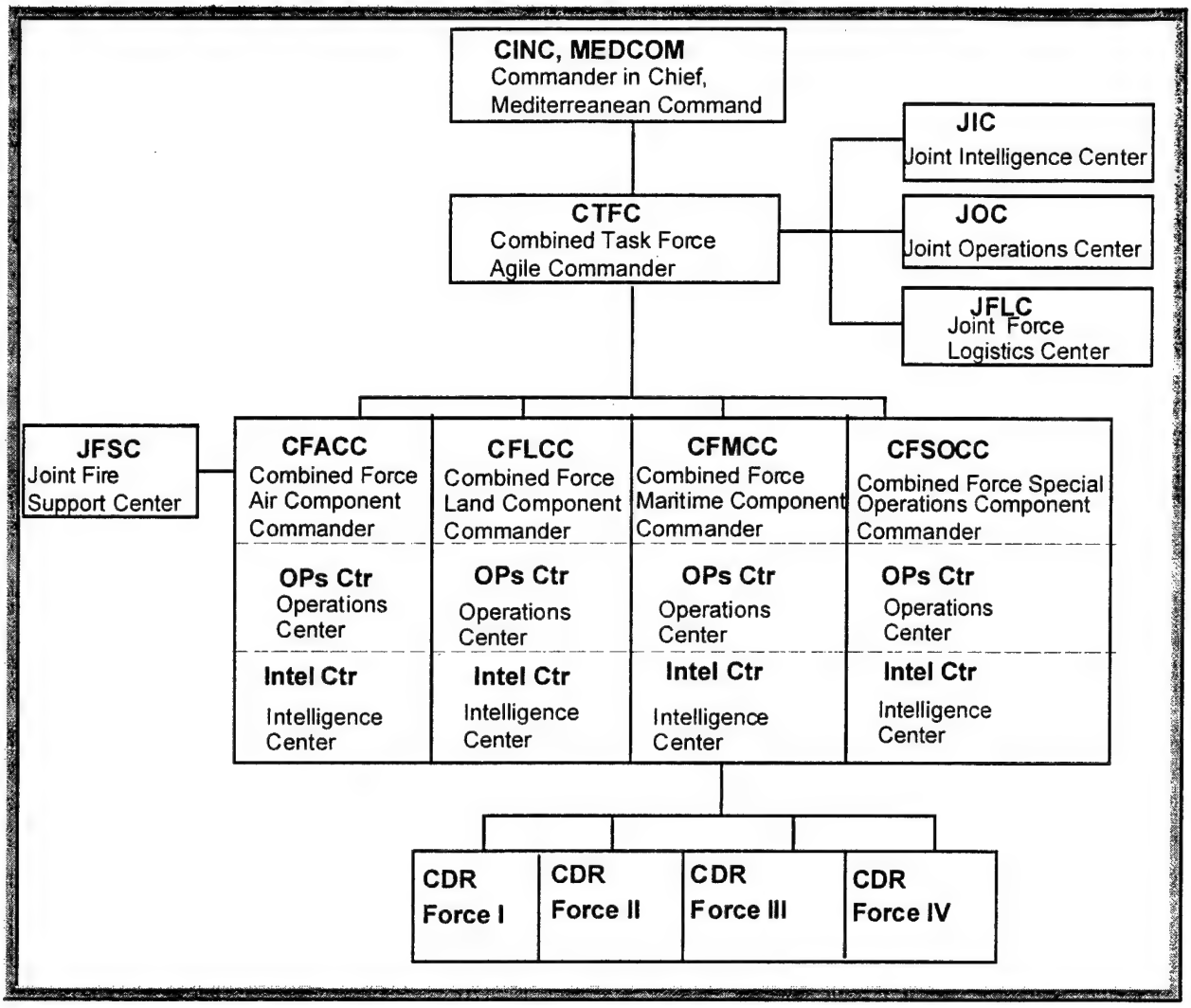


Understanding the Structure of the Organization

COMBINED TASK FORCE: SCENARIO PREPARATION

Rationale: Anytime you become involved with a new organization, it is essential that you take the time to get to know each person. Specifically, you need to know who the people in the new group or organization are and how they are "connected" to the other people in the organizaiton. This is sage advice for everyday life, as well as for your participation in the coming study. To prepare for this mission you must arrive at the study sight with a thorough understanding of the organization being used in the study. Following is an organizational chart and a general description of the primary communications nodes (i.e., people) involved in the study. **Upon your arrival at the session you will be tested to ensure you have sufficient knowledge of the organization.**

Organizational Chart



Normally when you join a new organization, you receive a chart like the one above. For the upcoming study, we want you to be able to focus on the study instead of having to learn about the people and their functions. For this purpose we have devised this booklet with explanations of the people in the organization.

CINC, MEDCOM: Commands MEDCOM (which includes Algeria & Tunisia).

CTFC: Tasked with three phased operation to destroy Algerian forces in Tunisia

JOC: Operations staff for CTFC. Monitors and deconflicts operations carried out by the component commanders.

JIC: Intelligence staff for CTFC. Collect, analyze, and disseminate enemy information.

JFLC: Clearing house for components' logistic requests. (e.g., food, fuel, ammo, transport).

CFACC: Allocation and control of all air assets (including missiles) assigned to CTF Agile.

CFACC Ops Ctr: Provides support to the component commander that JOC provides to CTFC.

CFACC Intel Ctr: Provides support to the component commander that JIC provides to CTFC.

JFSC: Central coordination for fire support requests.

CFLCC: Tasking, control, and coordination of all ground force units (non-SOF) ashore during ground operations.

CFLCC Ops Ctr: Provides support to the component commander that JOC provides to CTFC.

CFLCC Intel Ctr: Provides support to the component commander that JIC provides to CTFC.

CFMCC: Tasking, control, and coordination of all joint naval forces assigned to CTF Agile.

CFMCC Ops Ctr: Provides support to the component commander that JOC provides to CTFC.

CFMCC Intel Ctr: Provides support to the component commander that JIC provides to CTFC.

Cmdr FORCE I: Sever enemy logistic support lines.

Cmdr FORCE II: Operate against 5th Infantry Division, interdict coastal road.

Cmdr FORCE III: (Operations Deception): Conduct deception operations.

Cmdr FORCE IV: Seize Sfax, and destroy Algerian forces in Tunisia.

CFSOCC: Tasking, control, and coordination of all joint force special operations units.

CFSOCC Ops Ctr: Provides support to the component commander that JOC provides to CTFC.

CFSOCC Intel Ctr: Provides support to the component commander that JIC provides to CTFC.

TASK LOAD INDEX (TLX) WORKLOAD QUESTIONNAIRE

INSTRUCTIONS

Workload is a difficult concept to define precisely, but a simple one to understand generally. The factors that influence your experience of workload may come from the task itself, your feelings about your own performance, how much effort you put in, or the stress and frustration you felt. The workload contributed by different task elements may change as you become more familiar with a task, perform easier or harder versions of it, or move from one task to another. Physical components of workload are relatively easy to conceptualize and evaluate. However, the mental components of workload are more difficult to measure, so we offer the following discussion to help you with the problem.

Workload is something that is experienced individually by each person. There are no effective "rules" that can be used to estimate the workload of different activities. One way to find out about workload is to ask people to describe the feelings they experienced. Because workload may be caused by many different factors, we will ask you to evaluate each of the component factors individually rather than lumping them into a single global evaluation of overall workload.

The six rating scales used in this workload questionnaire were developed for you to use in evaluating your experience during a particular segment of the experiment. Please read the descriptions of the scales below carefully. If you have a question about any of the scales, you can ask them now or you can hold your questions until the first workload assessment period and ask them at that time, in the context of the task you have just performed. It is important that the scales are clear to you. The descriptions of the scales will always be available to you when you do your workload ratings. Ask if you wish to review them.

You will be asked to fill out a workload questionnaire after you complete each set of experiment trials. Please respond to each of the six rating scales in terms of your experiences for that set of trials by putting an "X" at the point on the scale that matches your experience. Each scale has two endpoint descriptors that describe the scale. In five of the six scales the end points for the scale are “very low” (on the left) and “very high” (on the right). Note that "performance" goes from "perfect" on the left to "failure" on the right. This order has been confusing for some people.

Please consider your responses carefully in distinguishing among the different task conditions. Consider each scale individually. Your accurate ratings will play an important role in the evaluation being conducted.

DEFINITION OF THE TLX SCALES

The **mental demand** scale asks you to rate how much mental and perceptual activity was required (e.g., thinking, deciding, calculating, remembering, looking, searching, etc.). Was the task or situation easy or demanding, simple or complex, exacting or forgiving? Make this rating on a scale from very low mental demand to very high mental demand.

The **physical demand** scale asks you to rate how much physical activity was required (pushing, pulling, turning, controlling, activating, etc.). Was the task or situation easy or demanding, slow or brisk, slack or strenuous, restful or laborious? Make this rating on a scale from very low physical demand to very high physical demand.

The **temporal demand** scale asks you to rate how much time pressure you felt due to the rate or pace at which the task or task elements occurred. Was the pace slow and leisurely or rapid and frantic? Make this rating on a scale from very low temporal demand to very high temporal demand.

The **performance** scale asks how successful you think you were in accomplishing the goals of the task or situation set by the mission (or yourself). How satisfied were you with your performance in accomplishing these goals? Make this rating on a scale from perfect (successfully accomplished everything) to failure (nothing was successfully accomplished).

The **effort** scale asks you to rate how hard you had to work (mentally and physically) to accomplish your level of performance. Make this rating on a scale from very low effort (not hard at all) to very high effort (very hard).

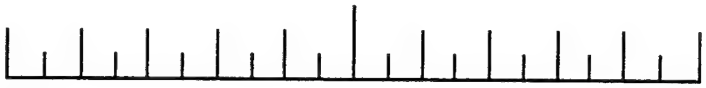
The **frustration level** scale asks how insecure, discouraged, irritated, stressed, and annoyed versus secure, gratified, content, relaxed, and complacent you felt during the situation that you just experienced. Make this rating on a scale from very low frustration to very high frustration.

TLX WORKLOAD QUESTIONNAIRE

SUBJECT ID:_____ DATE:_____

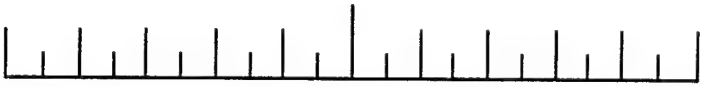
PLEASE RATE THE WORKLOAD YOU EXPERIENCED ON THE SIX SCALES BELOW BY PUTTING AN "X" ON EACH OF THE SCALES AT THE POINT THAT MATCHES YOUR EXPERIENCE

Mental Demand



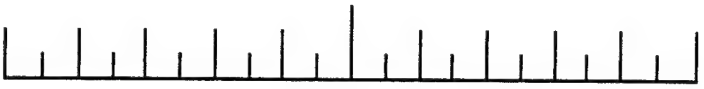
Very Low Very High

Physical Demand



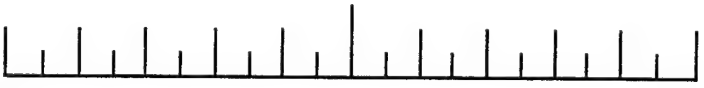
Very Low Very High

Temporal Demand
(Time Pressure)



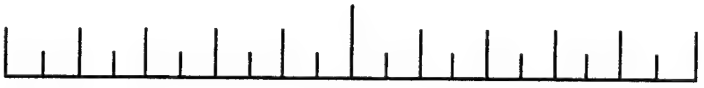
Very Low Very High

Performance



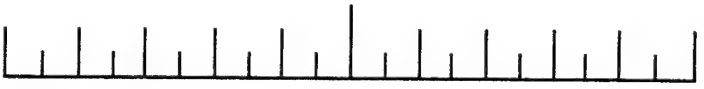
Perfect Failure

Effort



Very Low Very High

Frustration



Very Low Very High

BRIEFING PREPARATION FORM

Briefly answer the questions below in writing. Doing this will help you develop and focus your oral SITREP.

1. What is the most critical uncertainty right now and how are you trying to resolve it?

2. What information would you like to have right now to get a better assessment of the situation? Where (or who) will you try and get it from?

3. What predictions can you make based on what you know now as to how the situation may evolve?

4. What is your hypothesis at this time to explain how this situation occurred?

Rater's initials _____ Subject Number _____

SITUATION ASSESSMENT EVALUATION SCALE

A: Assessment of important themes: One point for each topic/theme mentioned.

Topic/Theme	Check (✓) if mentioned
Armored column vicinity of objective A **stopped to wait for fuel** (or **fuel trucks)**	
Algerian armed forces experiencing **difficulty moving fuel** to its units – **fuel trucks broken down or destroyed**; or resorting to **using unmarked or "relief agency" marked trucks to move fuel.**	
Armored column personnel (in vicinity of Objective A) do **not appear to be digging in or taking up defensive position**; or, personnel appear to be **milling around.**	
Enemy gunships (MI - 8 Helos) in vicinity of **Objective 1** are arming and fueling – **area may be "hot"**	
Some **SCUD and SAM launchers still operational** ; or, enemy using **decoys to simulate missile sites**	
Algerian armed forces (appear to be) **moving to protect transportation infrastructure** (e.g., rail, road, bridges) – e.g., near Tabarka	
Algerian forces **no longer moving into Tunesia** – Algerian forces appear to be massing in **preparation to repel counter invasion.**	
Total (add check marks)	

B: Overall accuracy of Situation Assessment: Using the attached sheet showing the information and instructions given to the subjects, and the 'ground truth' provided by our subject matter expert who developed this scenario, circle the number that best corresponds with the cadet's overall accuracy of the situation assessment; use the provided anchors to help choose the appropriate score.

1 2 3 4 5 6 7

(1)	(4)	(7)
Has little or no understanding of the situation, hypotheses held about the situation have no relationship to ground truth (e.g., fails to mention anything pertaining to Objective 1 or Objective A. Focuses on unrelated occurrences or simply says "I don't know what's going on")	Has limited understanding of the situation, hypotheses held have some similarities with, and some differences from, ground truth (e.g., believes that the armored column has run out of gas, and that it also poses a threat to Objective 1)	Has very accurate understanding of the situation, hypotheses held are very close to or exactly ground truth (e.g., Seems to know that the armored column poses no threat because it is simply waiting for fuel)

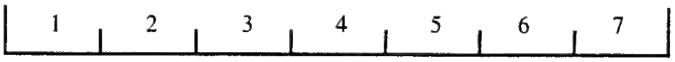
Comments/Notes on your overall rating:

POST-STUDY QUESTIONNAIRE

NAME:_____ DATE:_____ CLASS TIME: _____

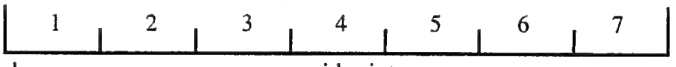
Please answer each question below. **Briefly** respond to the open-end questions. Please answer as honestly as you can; by doing so, you will help us refine the training to make it more effective. Turn the completed questionnaire in to Maj. Kewley in class 9 November 1999. **THANK YOU!**

1. After reading the "Road to War and Situation Brief," how clear was the current situation?



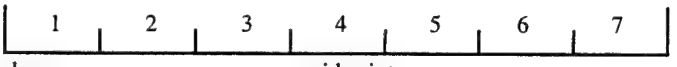
not very clear midpoint very clear

2. After you read the OP order prior to the beginning of the trial, how clear was what you had to do?



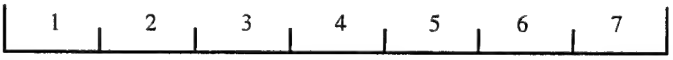
not very clear midpoint very clear

3. When you began the trial, how clear were you about how to use the e-mail message software?



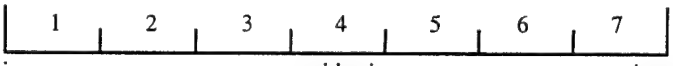
not very clear midpoint very clear

4a. Prior to the start of the trial, did you have sufficient time to consider the information and formulate a assessment of the situation?



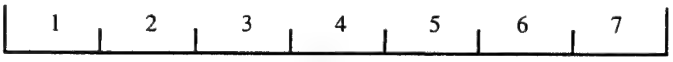
not enough time midpoint plenty of time

4b. During the trial, did you have sufficient time to consider the information and formulate a hypothesis as to what was occurring in the situation?



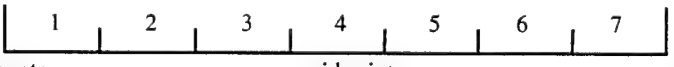
not enough time midpoint plenty of time

5a. How adequate was the time allotted to prepare your oral briefings?



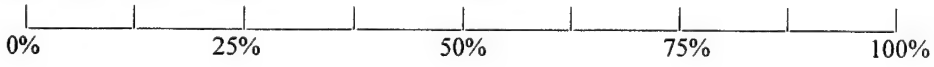
very inadequate midpoint very adequate

5b. How adequate was the time allotted to prepare the final written brief?



very inadequate midpoint very adequate

6a. What percentage of the messages did you leave unopened by choice?



6b. What criteria did you use to recognize messages to be left unopened by choice?

7. What percentage of the messages did you leave unopened because you did not have time to open them

0% 25% 50% 75% 100%

8a. What percentage of the written messages did you only skim and not read carefully?

0% 25% 50% 75% 100%

8b. What criteria did you use to know that skimming would be satisfactory?

9a. If you heard auditory messages, what percentage of the auditory messages did you leave unopened by choice?

0% 25% 50% 75% 100%

9b. If you heard auditory messages, what percentage did you play more than once?

0% 25% 50% 75% 100%

9c. How did you know (determine) which one(s) to replay?

9d. What was the principal reason you replayed a message?

10a. If you heard auditory messages, to what extent would you prefer them over written messages?

very little midpoint a lot

10b. If you did <u>not</u> hear auditory messages, to what extent do you think you would prefer verbal messages over written messages?

very little midpoint a lot

11. What criteria did you use to prioritize messages as to their criticality?

12a. How helpful was the information about organizational structure to you?

1 2 3 4 5 6 7

not very helpful midpoint very helpful

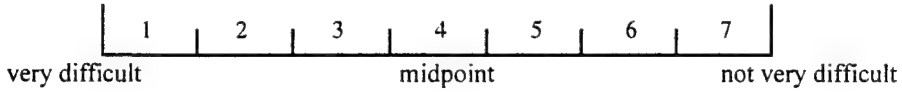
12b. In what way was the information about organizational structure helpful to you?

13a. How much information did you forward/send to other nodes?

1 2 3 4 5 6 7

very little midpoint a great deal

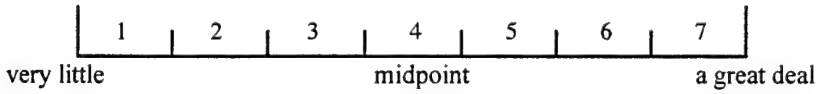
13b. How difficult was it to determine to what node to send information?



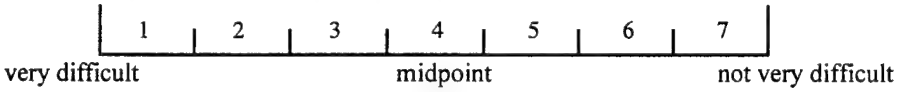
13c. What criteria did you use to decide what information to send?

13d. If you did not send information to other nodes, why not?

14a. How much information did you request from other nodes?



14b. How difficult was it to determine from what node to request information?



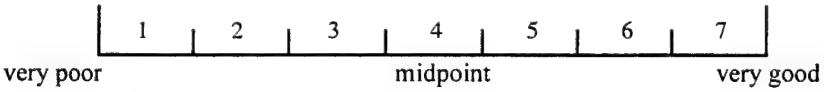
14c. What criteria did you use to decide what information to request from a node?

14d. If you did not request information from other nodes, why not?

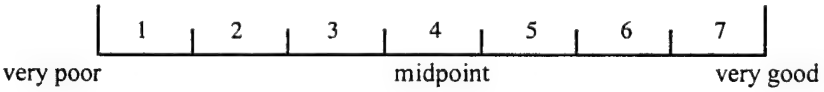
---

15. In general, what were the most important factors you considered when formulating your briefing?

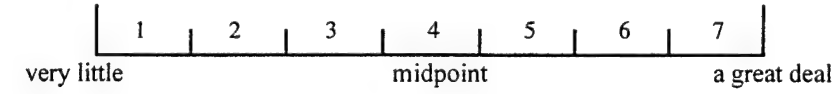
16a. What is your overall rating of the written training materials?



16b. What is your overall rating of the "in-class" training activities?



17a. To what extent did the skills you learned in training helped you remain focused on the mission?



17b. Please explain give an example.

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18. Any general comments about the study? _____

SAMPLE MESSAGES

Critical Messages

From:CTF_AGILE_INTELLIGENCE
Subject: INTEL UPDATE
DTG: 092330L SEP 08
Message Text:
SIGINT INTERCEPT INDICATES UNITS ASSOCIATED WITH THE 3RD CAA 3RD MECHANIZED INFANTRY DIVISION TRYING TO CONTACT REFUELING TRUCKS. NO RESPONSE.

From:CTF_AGILE_INTELLIGENCE
Subject: INTEL UPDATE
DTG: 092200L SEP 08
Message Text:
FUSED SOURCES INDICATE ALGERIANS ATTEMPTING TO REINFORCE TABARKA. INDICATE CRITICAL LOGISTICS NODE STILL EXISTS AT TABARKA DESPITE REPEATED AIRSTRIKES. RAILS SEVERED IN STRIKES ON 2 SEP APPEAR TO BE REPAIRED.

Nonrelevant Messages

From: MEDIA_SOURCES
Subject: MEDIA REPORTS
DTG: 092240L SEP 08
Message Text:
MEDIA REPORTS INDICATE THAT US AIR STRIKES NEAR KELAA-ES-SENAM HAVE RESULTED IN THE DESTRUCTION OF A RELIEF COLUMN MOVING FOOD, MEDICAL SUPPLIES, AND DIESEL FUEL TO A REFUGEE CAMP IN REBIB. 12 PEOPLE WERE REPORTED KILLED AND 6 INJURED. DETAILS ARE SKETCHY.

From: CTF_AGILE_INTELLIGENCE
Subject: INTELL UPDATE
DTG: 092330L SEP 08
Message Text:
HUMINT REPORTS INDICATED GROUP OF FUEL AND COMMERCIAL TRUCKS WITH RELIEF AGENCY MARKINGS TURNED OFF ROAD 49 AND ONTO ROAD 53 AT

APPROXIMATELY 2100L NEAR OUN TEBOUL, ALGERIA. TRUCKS WERE MOVING AT HIGH SPEED.

APPENDIX B

Background Questionnaire

Name _____ Date _____Time _____

The purpose of this questionnaire is to obtain some information about your military background and experiences. This information will be used to better understand your responses. All information collected will remain confidential and will not be released to third parties. We appreciate your cooperation in completing this form.

Current Status: _____Active Duty
_____Retired; Date of separation _____

Rank _____ Branch_____ Specialty _____

Time in grade _____ Time in Service ____ years

Last service school attended _____ Year _____

How many exercises have you participated in as a G-3 or S-3 _____

What was the last one? _____

Name: _____ Date/Time: _____

Decision Making in Distributed Organizations

Post-training questionnaire

As quickly as possible, please answer the following questions. Please make your answers brief and concise.

1) What is one way the Army of the future will be different from that of today?

2) You have just been charged with monitoring message flow to help handle a very complicated situation, there are 56 messages in the inbox; briefly describe how you should proceed.

3) Based on your knowledge of "typical" information exchanges during wartime:
   a) what percentage of those 56 messages in Item # 2's inbox do you think would be critical for your task?

   b) What percentage would be irrelevant?

4) What is a technique you can use to decide if a message is relevant for your task?

5) How is the structure of the organization used in this research different from the organization of today?

PREP SHEET

Name _____ Date/time _____

BRIEFING PREPARATION FORM

Briefly answer the questions below in writing. Doing this will help you develop and focus your oral SITREP.

1. What is the most critical uncertainty right now and how are you trying to resolve it?

2. What information would you like to have right now to get a better assessment of the situation? Where (or who) will you try and get it from?

3. What predictions can you make based on what you know now as to how the situation may evolve?

4. What is your hypothesis at this time to explain how this situation occurred?

Rater's initials _____ Subject Number _____

SITUATION ASSESSMENT EVALUATION SCALE

INTERIM BRIEFING

A: Assessment of important themes: One point for each topic/theme mentioned.

Topic/Theme	Check (✓) if mentioned
9th Algerian Mech Division increased activity (e.g., increased alert status, conducting preparations for combat, logistics stockpiling, equipment maintenance, rehearsal activity) indicates they are going to relocate or conduct combat operations	
Algerian refueling activities implies major relocation, not just minor shifts	
Increased security at the command post suggests major planning efforts ongoing	
Movement of goods West to East across Tunisia suggests movement to reinforce forces vicinity Tunis. (Don't necessarily have to believe they are going to reinforce 9th Div in order to make salient point)	
Influx of barrier materials and mines to the 9th Algerian Mech Division suggests they will conduct defensive operation	
Air screen to the south of NAIs 34 and 35 suggests enemy moving south: could be to Sousa, or perhaps to Sfax	
Enemy movement (e.g., APCs, armor, artillery) around El Djam and south of NAIs 34 and 35 toward Sfax suggesting preparations for a defense against forces attacking from the south	
Algerian order to conduct defense with phased movement from the current location to the defensive sector also suggests enemy may be moving south.	
Possible compromise of CTF intentions through Libyan observations	
9th Div represents a threat to Force IV security and mission accomplishment	
Total (add check marks)	

B: Overall quality of Situation Assessment: Circle the number that best corresponds with the subject's overall accuracy of the situation assessment; use the provided anchors to help choose the appropriate score.

1	2	3	4	5	6	7
(1)			(4)			(7)
Has little or no understanding of the situation, hypotheses held about the situation have no relationship to ground truth . Briefing only reiterates information given in the Vignette (e.g., states there is increased activity in 9th Algerian Mech Div., says deception plan working but gives no evidence)			Has limited understanding of the situation, hypotheses held have some similarities with, and some differences from, ground truth . Goes somewhat beyond stated information in integrating separate messages, suggesting implications, etc. Gives some backup for conclusions. (e.g., mentions one factor that indicates 9th Mech may be moving south.)			Has very accurate understanding of the situation, hypotheses held are very close to or exactly ground truth . Understands implications of information in messages. Backs up all conclusions. Suggests next planning steps needed (e.g., draws appropriate inferences and implications from activities south of NAI 34/35, describes info/allocations needed from CTF Agile).

Rater's initials _____ Subject Number _____

C: How well did subject integrate information contained in messages: Circle the number that best corresponds with the subject's overall accuracy of the situation assessment; use the provided anchors to help choose the appropriate score.

1	2	3	4	5	6	7
(1)			(4)			(7)
May provide individual pieces of information, but gives no evidence he/she is putting separate pieces of information together			Puts together information from some messages and projects implications to limited extent (e.g. sees relationship between logistics movement and troop activities)			Pulls together all information provided into coherent picture. States critical information and appropriate relationships among different pieces. (e.g. see relationship between activities in Tunis, 9th Div and western LOCs).

D: To what extent and how well (appropriately) did subject provide the means to improve SA and reduce uncertainty: Circle the number that best corresponds with the subject's overall accuracy of the situation assessment; use the provided anchors to help choose the appropriate score.

1	2	3	4	5	6	7
(1)			(4)			(7)
Offered no suggestions, or only vague notions, for where additional or supporting information could be obtained.			Makes some suggestions for what kinds of information should be sought and where to look for it. (e.g., requests coverage of 9th Mech Div or movement of forces; suggests one possible alternative for obtaining info)			Makes several suggestions for information needed and where it should be obtained (e.g., establish new NAIs, tasking JSTARS, coordinate w/ Force IV G2 for coverage of movement of forces from 9th Mech Div AO north and south, request recon assets from higher)..

Comments/Notes:

Rater's initials _____ Subject Number _____

SITUATION ASSESSMENT EVALUATION SCALE

FINAL BRIEFING

A: Assessment of important themes: One point for each topic/theme mentioned.

Topic/Theme	Check (✓) if mentioned
Enemy movement (e.g., APCs, armor, artillery) around El Djam and south of NAIs 34 and 35 toward Sfax suggesting preparations for a defense against forces attacking from the south	
Risk to Force IV operations vicinity Sfax – lack of supporting ODA team, other Algerian activities vicinity Sfax.	
Required information or planning steps necessary to change mission to new objectives (identify necessity to begin planning for new branch of Operation AGILE, identification of key factors affecting change in mission, e.g. ability of 9th affect operations to north and south)	
Movement of goods West to East across Tunisia suggests movement to reinforce forces vicinity Tunis. (Don't necessarily have to believe they are going to reinforce 9th Div in order to make salient point)	
Operations security (e.g. steps needed to avoid allowing Algerian forces to detect intentions of CTF or Force IV, possible compromise of CTF intentions through Libyan observations)	
Total (add check marks)	

B: Overall quality of Situation Assessment: Circle the number that best corresponds with the subject's overall accuracy of the situation assessment; use the provided anchors to help choose the appropriate score.

1	2	3	4	5	6	7
(1)			(4)			(7)
Has little or no understanding of the situation, hypotheses held about the situation have no relationship to ground truth . Briefing only reiterates information given in the Vignette (e.g., states there is increased activity in 9th Algerian Mech Div., says deception plan working but gives no evidence)			Has limited understanding of the situation, hypotheses held have some similarities with, and some differences from, ground truth . Goes somewhat beyond stated information in integrating separate messages, suggesting implications, etc. Gives some backup for conclusions. (e.g., mentions one factor that indicates 9th Mech may be moving south.)			Has very accurate understanding of the situation, hypotheses held are very close to or exactly ground truth . Understands implications of information in messages. Backs up all conclusions. Suggests next planning steps needed (e.g., reference to new planning required, describes info/allocations needed from CTF Agile).

Rater's initials _____ Subject Number _____

C: How well did subject integrate information contained in messages: Circle the number that best corresponds with the subject's overall accuracy of the situation assessment; use the provided anchors to help choose the appropriate score.

1	2	3	4	5	6	7
(1)			(4)			(7)
May provide individual pieces of information, but gives no evidence he/she is putting separate pieces of information together			Puts together information from some messages and projects implications to limited extent (e.g. sees relationship between logistics movement and troop activities)			Pulls together all information provided into coherent picture. States critical information and appropriate relationships among different pieces. (e.g. see relationship between activities in Tunis, 9th Div and western LOCs).

D: To what extent and how well (appropriately) did subject provide the means to improve SA and reduce uncertainty: Circle the number that best corresponds with the subject's overall accuracy of the situation assessment; use the provided anchors to help choose the appropriate score.

1	2	3	4	5	6	7
(1)			(4)			(7)
Offered no suggestions, or only vague notions, for where additional or supporting information could be obtained.			Makes some suggestions for what kinds of information should be sought and where to look for it. (e.g., requests coverage of 9th Mech Div or lack of coverage where ODA Tm now missing; suggests one possible alternative for obtaining info)			Makes several suggestions for information needed and where it should be obtained (e.g., establish new NAIs, tasking JSTARS, coordinate w/ Force IV G2 for coverage of 9th Mech and other forces affecting new objectives, request recon assets from higher, collection capabilities vicinity of new objectives)..

Comments/Notes:

POST-STUDY QUESTIONNAIRE

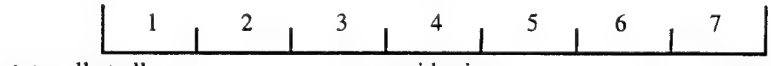
NAME:_____ DATE:_____ TIME: _____

Please answer the questions below as honestly as you can; by doing so, you will help us refine the training to make it more effective. **THANK YOU!**

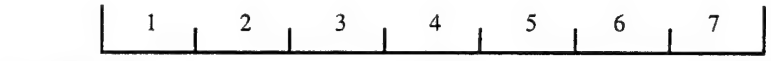
Part I. The scenario and your task

1. After receiving the Road to War and Situation Briefing, how clear was the current situation?

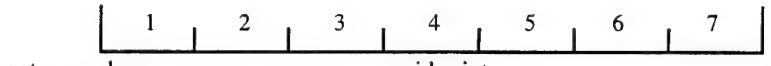
2. When you started the data collection trial, how well did you understand the mission?



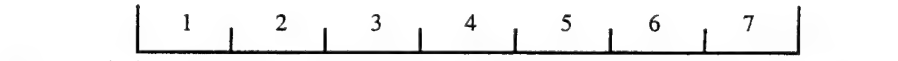
4. When you began the trial, how clear were you about your task?



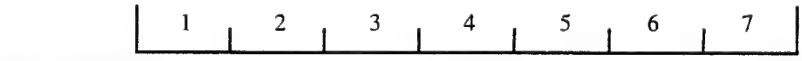
4. When you began the trial, how clear were you about your information needs?



5. During the trial, did you have sufficient time to consider the information and formulate a hypothesis as to what was occurring in the situation?



6. During the trial, to what extent were you distracted by information you did not need?

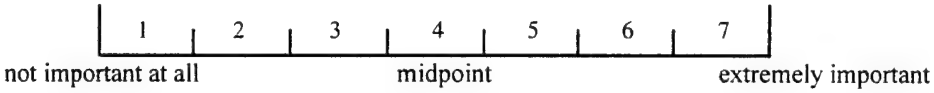


7. In general, what were the most important factors you considered when formulating your briefing?

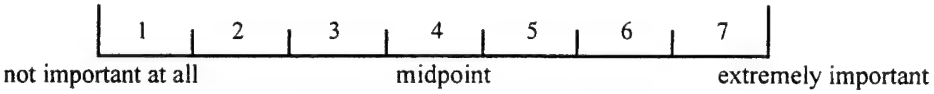
Part 2: Information Processing

8. How important were each of the following aspects of the header to you in deciding whether to open a message?

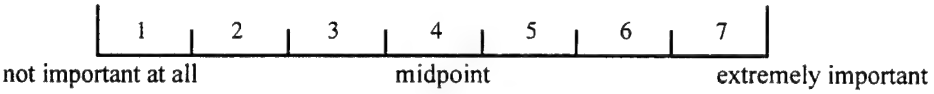
8a. Source (from):



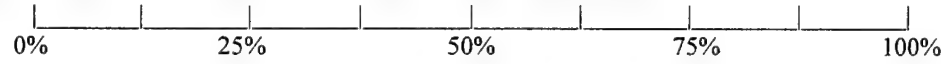
8b. Time:



8c. Subject:



9. What percentage of the messages did you leave unopened **by choice**?



9a. What criteria did you use to recognize messages to be left unopened by choice?

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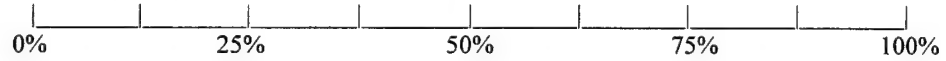
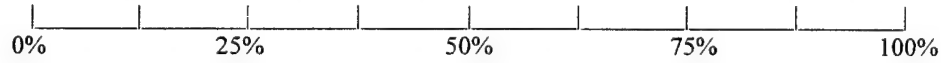
10. What percentage of the messages did you leave unopened because you **did not have time to open them**



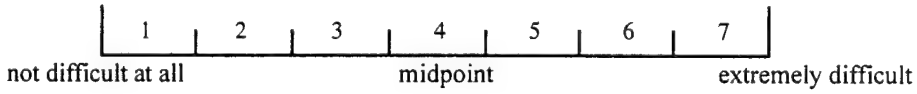
11. Of the messages you opened, what percentage of the messages did you only scan and not read carefully?



12. What criteria did you use to know that scanning was satisfactory?

---

13. When you read a message, how difficult was it to integrate the information with other messages in order to develop a hypothesis about what was happening in the situation?



14. What criteria did you use to evaluate the importance of messages?

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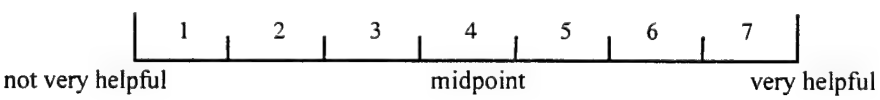
15. How helpful was the information about organizational structure to you in processing the messages?



16. How did you use the information about the organizational structure in processing the messages?

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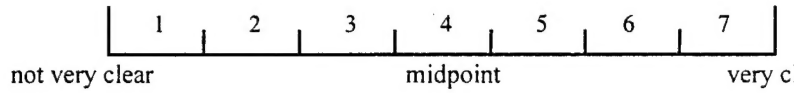
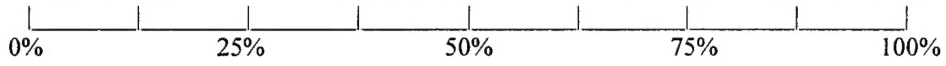
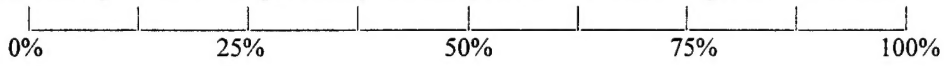
17. How clear were you about the information needs of other nodes in the organization?



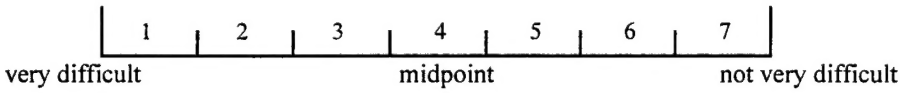
18.Of the messages you opened, what percentage did you forward without any changes to another node?



18a. What percentage of the messages you opened did you forward with changes to another node



19. How difficult was it to determine to what node to **send** information?



20. What criteria did you use to decide what information to send?

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21. If you did not send information to other nodes, why not

____ It wasn't necessary to send any information to other nodes

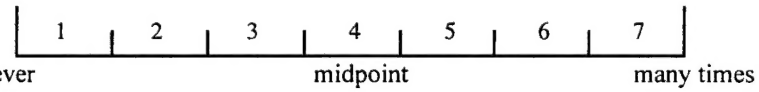
____ Didn't have enough time

____ Didn't know where to send the information

____ Didn't know what information to send

____ Other: Please specify)_____

22. How many times did you **request** information from other nodes?



23. What criteria did you use to decide what information to request from a node?

---

24. If you did not request information from other nodes, why not?

____ Didn't have enough time

____ Didn't need any information

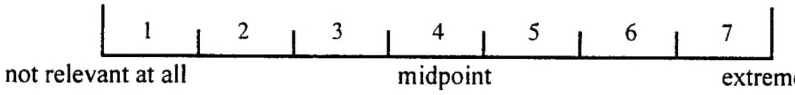
____ Didn't know where to get the information

____ Didn't know what to ask

____ Other: Please specify)_____

Part 3: Training Evaluation

25. How relevant was the information in the training program for you?



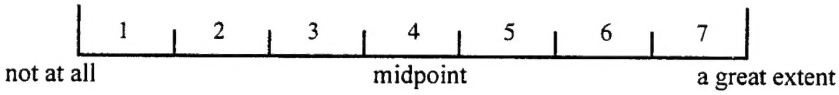
26. Did you learn any strategies in the training that helped you cope with the amount of information in the data collection scenario? I learned:

___None ____1 or 2 _____several.

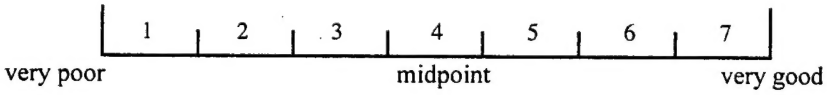
27. Please give an example of a strategy you used. _____

_____

28. To what extent do you think this training is applicable to dealing with large volumes of information in your real work?



29. What is your overall rating of the training program?



30. What suggestions do you have for improving the training? _____

_____

31. Any general comments about the study? _____

_____

Sample Messages
Evaluation Vignette

Critical

From: G2, CTF AGILE
To: CDR, FORCE IV
Subject: INTEL UPDATE
DTG:09 1720L SEP 08
Message Text:
Current estimate of 9th Algerian Mech Division activities: 9th Algerian Mech Division is currently at an increased alert status and conducting preparations for combat, including logistics stockpiling, equipment maintenance, and rehearsal activity. Activity indicates probable change of mission and likely execution within 12 to 48 hours.

From: JSTARS
To: CDR, FORCE IV
Subject: SPOT REPORT: APCs and tanks moving toward El Djam
DTG:09 2100L SEP 08
Message Text:
Approximately three battalions' worth of Enemy APCs and tanks are moving southeast toward El Djam (35-18N 010-44E). A ground reconnaissance squadron has established security and traffic control forward of the movement. There is also an increase of air activity in an apparent guard mission in support of this ground movement.

Relevant

From: FORCE IV MI (IEW Unit)
To: CDR, FORCE IV
Subject: SIGINT REPORT: Increased traffic from vicinity of 9th Algerian Mech Division
DTG: 09 1700L SEP 08
Message Text:
SIGINT has detected radio increased radio communications from assumed command and logistics nodes in the vicinity of the 9th Algerian Mech Division. There has been a corresponding slight increase in radio

transmissions from nodes in Tunis. Transmissions are coded and not yet intelligible.

From: ODA Team 1
To: CDR, CTF AGILE; CDR, FORCE IV
Subject: SPOT REPORT: NAI 35
DTG: 09 1810L SEP 08
Message Text:
12 refuel tankers arrived in the 9th Algerian Mech Division support area (NAI 35) at 091730L SEP 08. Unit tanks and mechanized infantry vehicles have begun refuel operations.

Nonrelevant

From: G3, CTF AGILE
To: CTF AGILE
Subject: SITREP: Additional strikes ordered against rail LOCs
DTG: 09 1820L SEP 08
Message Text:
Rail LOCs in the vicinity of Tabarka have been redesignated as air strike targets for the next 12 hours.

From: G2, CTF AGILE
To: CTF AGILE
Subject: INTREP: Ship Attack
DTG: 09 2150L SEP 08
Message Text:
An Algerian Osaii fired two SS-2 missiles at the CVBG operating north of Cap Rosa. Both missiles were destroyed in the air by the USS George Appleton, an Aegis destroyer. Both the Osaii firing the missiles and the Osaii in company were reported sunk in Tunisian waters.